PLASTER OF PARIS TECHNIQUE

Dedicated to

HOWARD

and our dear Parents

PRINTED IN GREAT BRITAIN

PLASTER OF PARIS TECHNIQUE

By

MARIAN ENGLISH

S.R.N., R.F.N.

Late Sister-in-Charge, Plaster Department,
Ancoats Hospital, Manchester 4

FOREWORD

By

D. Ll. GRIFFITHS, M.B.E., F.R.C.S.

Surgeon-in-Charge, Manchester University Department of Orthopaedic Surgery, Manchester Royal Infirmary, Senior Visiting Orthopaedic Surgeon, Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry



E. & S. LIVINGSTONE LTD.

EDINBURGH AND LONDON

1957

FOREWORD

DURING the First World War Mr. Harry Platt, later Sir Harry Platt, P.R.C.S., established a Fracture Clinic in the Ancoats Hospital, Manchester. This clinic was the irst of its kind, and it became the model upon which so many thers were to be based. From the start, the successive sisters in harge of that clinic have been its pivots, and Mrs. English, the uthor of this monograph, was until recently the holder of that post. She inherited the techniques of Plaster of Paris work which have been evolved in Ancoats, but she has also developed several new methods of her own. As a result, she is able to give an authoritative and detailed account of the preparation and application of Plaster of Paris casts and splints.

All the methods she describes are detailed step by step in the way she has taught them to many nurses and surgeons. I believe that this practical hand-book will be of real and lasting value to everyone who uses Plaster of Paris, for orthopaedic surgery is unlikely to be able to do without that substance in the lifetime of any of us.

The indebtedness of orthopaedic surgeons and of their patients to 'plaster-sisters' is often forgotten The Plaster of Paris bandage has been in use for little more than a century Shortly after its introduction, a well-known text-book of the treatment of fractures described 'plaster of Paris moulds' as ' . . not entitled to serious consideration. Heavy stone coffins, they might serve well enough the purposes of interment, but they are wholly unsuited to the purposes of a splint.' Many of us, remembering the heavy and cumbersome plasters of not more than twenty-five years ago, can appreciate the truth of that criticism The revolution which has made a plaster cast the most comfortable, the best and the most useful of all splints has been largely due to plaster-sisters such as Mrs English. We are all in their deb

. GRIFFITHS

PREFACE

THE application of Plaster of Paris to any part of the human body is an art which can be acquired only by practice of the technique.

It is essential that any person applying a plaster cast should have a thorough knowledge of its purpose, and of the complications which may arise from its incorrect application.

A satisfactory result depends almost entirely on a cast sufficiently strong to serve its purpose yet as light as possible to ensure comfort for the patient. This is achieved by attention to detail.

I have written the details of plaster technique primarily for the benefit of nurses who work in the busy fracture department of my own general training school, where perhaps I was better known as Sister Newton. They receive an initial period of three weeks' instruction and supervision and are then allowed to apply simple plasters unaided. They also assist in the application of the more difficult casts required in surgery of the limbs, shoulder, spine and hip

The practical points of plastering are rarely described and I have tried to present them simply and clearly to the reader, with the trust that he or she may benefit from my own experience as a plaster room sister

I am most grateful to Mr D. Ll. Griffiths for reading and advising on the manuscript and illustrations, and for writing the Foreword, and wish to thank his secretaries, Mrs. Openshaw and Miss Tocher, for their help in many ways. My special thanks are due to the North Manchester Hospital Management Committee for the facilities afforded me at Ancoats and other hospitals in the group to obtain photographs, and to Miss Jean Perry for taking the photographs and preparing the line drawings.

I am indebted to the Department of Medical Photography at the Manchester Royal Infirmary for providing the Figures 43, 70, 87, 107, and 130, and to Sister Tushingham for her assistance and for allowing me full use of the Plaster Department of the Manchester Royal Infirmary

I [illegible] Mr F C B[illegible]

the field of orthopaedic nursing which held my interest; and the nurses of Ancoats Hospital who with other members of the staff have given much help in the preparation of this book.

Finally, I express my warmest thanks to my husband, Dr. H. L. English, for typing the manuscript; to his father, Dr. Howard English, for his encouragement; to Messrs E. & S. Livingstone for publishing the book and allowing me to use certain illustrations from *Surgery of Modern Warfare*; and to Mr. Charles Macmillan for his advice, interest and acceptance of the manuscript.

MARIAN ENGLISH

1957

CHAPTER I

THE PLASTER DEPARTMENT

In general hospitals, plastering facilities vary according to the number of cases treated. In some, the plaster room is part of the casualty department and plasters are applied by any member of the staff who is available at the time. The casts required after operations or for in-patients are usually the responsibility of the theatre or orthopaedic wards. This arrangement appears to work quite well in the smaller hospital where fractures are few in number, but in heavy industrial areas which have a high accident rate a separate unit concerned solely with plastering throughout the hospital is the ideal. Each patient receives treatment by a properly trained and responsible team, and errors are avoided by careful supervision.

RECORDS

It is well known that in recent years there has been a marked increase in litigation, and the field of plastering has not escaped the law courts. While the majority of patients are co-operative and appreciate one's efforts to help them, a small minority are hypercritical and discontented, are ready to blame everyone but themselves for their misfortunes, and will appeal to the courts of law if the results of treatment, however carefully carried out, do not come up to their expectations.

In these circumstances, the best defence for a plaster-room staff may be an accurate and detailed record of the case history. Everything ordered for, given to, or refused by the patient should be carefully written in ink or typed, and the statement initialled by the person who makes it. The date of the consultation should never be omitted. Two plaster record books are essential: the first should state the date, name of patient, the diagnosis, type of plaster and by whom applied; and the second a detailed account of all plasters applied under anaesthesia, with particulars of the date, name, address and age of the patient, the diagnosis, operation and treatment, the operator, the anaesthetist and the

the field of orthopaedic nursing which held my interest; and the nurses of Ancoats Hospital who with other members of the staff have given much help in the preparation of this book.

Finally, I express my warmest thanks to my husband, Dr. H. L. English, for typing the manuscript; to his father, Dr. Howard English, for his encouragement; to Messrs. E. & S. Livingstone for publishing the book and allowing me to use certain illustrations from *Surgery of Modern Warfare*; and to Mr. Charles Macmillan for his advice, interest and acceptance of the manuscript.

MARIAN ENGLISH

1957

CHAPTER I

THE PLASTER DEPARTMENT

IN general hospitals, plastering facilities vary according to the number of cases treated. In some, the plaster room is part of the casualty department and plasters are applied by any member of the staff who is available at the time. The casts required after operations or for in-patients are usually the responsibility of the theatre or orthopaedic wards. This arrangement appears to work quite well in the smaller hospital where fractures are few in number, but in heavy industrial areas which have a high accident rate a separate unit concerned solely with plastering throughout the hospital is the ideal. Each patient receives treatment by a properly trained and responsible team, and errors are avoided by careful supervision.

RECORDS

It is well known that in recent years there has been a marked increase in litigation, and the field of plastering has not escaped the law courts. While the majority of patients are co-operative and appreciate one's efforts to help them, a small minority are hypercritical and discontented, are ready to blame everyone but themselves for their misfortunes, and will appeal to the courts of law if the results of treatment, however carefully carried out, do not come up to their expectations.

In these circumstances, the best defence for a plaster-room staff may be an accurate and detailed record of the case history. Everything ordered for, given to, or refused by the patient should be carefully written in ink or typed, and the statement initialled by the person who makes it. The date of the consultation should never be omitted. Two plaster record books are essential: the first should state the date, name of patient, the diagnosis, type of plaster and by whom applied, and the second a detailed account of all plasters applied under anaesthesia, with particulars of the date, name, address and age of the patient, the diagnosis, operation and treatment, the operator, the anaesthetist and the

anaesthetic given. These books, if required in court, could save much inconvenience and embarrassment. This aspect of plastering should never be ignored, and is important to the career of any one of the orthopaedic team

DUTIES AND SPECIAL RESPONSIBILITIES OF STAFF

The surgeon-in-charge is responsible for all the work carried out in the plaster room. His duties allow little time to be devoted to the actual plastering. Normally this work is carried out by specially trained nurses working in conjunction with the junior surgical staff. The unit consists of a plaster sister, whose duty is to maintain efficiency in the department and in her staff nurses and trainees. A good team-spirit helps to promote a smooth running concern.

REQUIREMENTS FOR AN EFFICIENT PLASTER UNIT

Today there is a constantly growing demand by all hospital departments for increased accommodation, and the plaster unit often fares badly in this respect, but, however limited the accommodation provided, proper and sufficient equipment can and must be provided

The plaster room should have a large porcelain sink with a good drainage, as the passage of plaster cream and loose pieces of set plaster cannot always be avoided. Plaster powder should be stored in a warm dry place to prevent deterioration, and a trough or tray is necessary for the making of plaster bandages. Empty biscuit-tins provide excellent storage for plaster bandages, and can be painted cream to improve their appearance, with the size clearly indicated in a contrasting colour. For the making of slabs, a hard smooth surface is advocated. A shelf or table with a vitrolite, plate-glass or marble top is ideal for this purpose. Pails and bowls are required for the soaking of bandages, and mackintosh aprons and covers are needed for the protection of clothing. Sandbags are required in varying shapes and sizes for the comfortable cradling and support of the lower limbs. A full-length tape measure is an individual 'must' for every member of the staff. It is required several times each day.

Couches, trolleys, wheelchairs and foot stands should be sufficient in number to supply the needs of patients with injuries to the trunk or lower limbs. The X-ray department may be some

distance away from the plaster room, and power points should be installed for the convenience of taking films by portable machine. X-ray illuminators should be fixed at the most convenient points for the viewing of films.

Among the essential equipment for both application and removal of plasters there must be at least three pairs of strong straight scissors, plaster knives or scalpels, plaster shears of different sizes, plaster levers and spreaders. Razors, ring cutters and wire cutters are also necessary for daily use, and general

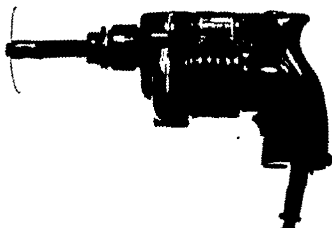


FIG 1 —The Desoutter electric plaster cutter.

instruments for dressing-trolleys should be sufficient in number to satisfy the needs of the department. An electric plaster cutter with an oscillating wheel (Fig. 1) ensures quick and painless removal of *padded* plasters. It is designed, by means of fine oscillations of the wheel, to cut through hard substance only, and there is little danger of penetrating the skin when light pressure is used, but the wheel becomes hot from friction and the patient often feels the heat produced, through the padding. For this reason it must be used with care, and *never on unpadded plasters*, or a burn may result. **Sparking can be seen in the motor, and therefore the cutter must not be used in the presence of inflammable liquids or gases, in particular, oxygen and ether, or an explosion may occur with a risk of injury to both patient and staff.**

Several sizes of syringes and needles are needed for simple injections, intravenous anaesthesia and joint aspirations, which are frequently performed in the plaster department, and all general equipment for the sterilisation of bowls, instruments and dressings is a necessary addition to the inventory.

There should be enough cupboards and drawers in which to keep special dressings which are used solely for orthopaedic cases. Cardboard and felt collars, and cervical and axillary muffs are in constant demand, and a ready-made stock in a number of sizes saves much time during a busy clinic. Stockinette and plaster wool rolls also take up much space, and provision should be made for this bulky stock which a plaster room should have in hand.

THE SPLINT ROOM

Any orthopaedic department should be equipped with splints in common use, and the supply should meet the demand Sizes have to be kept in duplicate or triplicate. A number of splints and appliances are padded and bound with leather. They may be in use only occasionally and should be kept covered to prevent soiling. Crutches and elbow crutches should be supplied in heights suitable for children and adults, and walking-sticks supplied in pairs are also a necessity. *No crutch or stick should be issued without a rubber protective pad at its base.* It would be shameful if a patient were to fall and injure himself as a result of having unprotected crutches or sticks. Walking-irons are seldom used, but a small stock is advisable. The metal rusts if left exposed, but a thin coat of grease prevents this. Rubber-tyre soles should be thoroughly cleaned after use, and buckles and straps examined for defects before placing in order of size on an open shelf. Wooden and metal splints may be stored on open shelves but covered with a dust sheet.

THE PLASTER THEATRE

The same equipment is needed in the plaster theatre as in the plaster room, with additional equipment for the application of hip spicas and plaster jackets. There are several designs of orthopaedic tables used in the application of a hip spica, all satisfactory, with shoulder, pelvic and foot rests. They enable the patient to be supported firmly but leave the trunk and limbs

free for the convenience of the person applying the cast. It is an advantage to have two of these tables, and each can be of a different type.



FIG 2—A type of head suspension apparatus. The patient is suspended by a padded leather halter pulling on the lower jaw and occiput. A plain calico sling is substituted for this if the plaster has to be taken over the head and neck before the tension is relaxed.

A suspension apparatus from the ceiling, or a standard suspension frame, is necessary for the treatment of certain spinal conditions, and is likely to be used only in the plaster theatre. The principle of both types is the same. A halter is fixed on the patient's head with the pull from the lower jaw and the occiput (Fig. 2). Tension is gradually applied until almost the full body

Several sizes of syringes and needles are needed for simple injections, intravenous anaesthesia and joint aspirations, which are frequently performed in the plaster department, and all general equipment for the sterilisation of bowls, instruments and dressings is a necessary addition to the inventory.

There should be enough cupboards and drawers in which to keep special dressings which are used solely for orthopaedic cases. Cardboard and felt collars, and cervical and axillary muffs are in constant demand, and a ready-made stock in a number of sizes saves much time during a busy clinic. Stockinette and plaster wool rolls also take up much space, and provision should be made for this bulky stock which a plaster room should have in hand.

THE SPLINT ROOM

Any orthopaedic department should be equipped with splints in common use, and the supply should meet the demand. Sizes have to be kept in duplicate or triplicate. A number of splints and appliances are padded and bound with leather. They may be in use only occasionally and should be kept covered to prevent soiling. Crutches and elbow crutches should be supplied in heights suitable for children and adults, and walking-sticks supplied in pairs are also a necessity. *No crutch or stick should be issued without a rubber protective pad at its base.* It would be shameful if a patient were to fall and injure himself as a result of having unprotected crutches or sticks. Walking-irons are seldom used, but a small stock is advisable. The metal rusts if left exposed, but a thin coat of grease prevents this. Rubber-tyre soles should be thoroughly cleaned after use, and buckles and straps examined for defects before placing in order of size on an open shelf. Wooden and metal splints may be stored on open shelves but covered with a dust sheet.

THE PLASTER THEATRE

The same equipment is needed in the plaster theatre as in the plaster room, with additional equipment for the application of hip spicas and plaster jackets There are several designs of orthopaedic tables used in the application of a hip spica, all satisfactory, with shoulder, pelvic and foot rests. They enable the patient to be supported firmly but leave the trunk and limbs

CHAPTER II

MATERIALS USED IN PLASTERING

PLASTER OF PARIS

PLASTER of Paris is the most effective substance used in the immobilisation of the trunk and limbs. It is made from calcium sulphate, which occurs in nature in two main forms:

1. Gypsum ($CaSO_4.2H_2O$), in which each molecule carries two molecules of water of crystallisation; and
2. Anhydrite ($CaSO_4$), which, as its name implies, is anhydrous and does not contain water of crystallisation.

Both these forms are stable, and deposits of them do not readily change from one to the other. *Only gypsum is of use in the making of Plaster of Paris*, which is obtained by crushing gypsum and carefully roasting it to about 130° Centigrade, to drive off some of the water of crystallisation. This process is carried out in special establishments, since, if the gypsum is roasted for too long a period, or its temperature allowed to rise above 200° Centigrade, it is completely dehydrated and converted to anhydrite, or 'burnt plaster'. This will not set on the addition of water and is therefore useless. If, on the other hand, the gypsum is insufficiently roasted, the plaster powder will not set firmly when water is added, and, similarly, if roasted plaster is exposed to a damp atmosphere, it will lose its property of setting.

Plaster of Paris ($CaSO_4.\frac{1}{2}H_2O$) is a white amorphous powder, unlike the crystalline state from which it is made. When the powder is immersed in water, it again crystallises to form gypsum and a solid mass. This is accompanied by an increase in volume, so that when a cast is made from the plaster, it moulds itself to the part to which it is applied. For this reason, plaster bandages should not be pulled tightly over a limb, since, on setting, they will get tighter and cause constriction.

The setting of plaster is retarded by a variety of substances which decrease the solubility of gypsum. Those mentioned in

weight is borne by the head, and in this position the spine is manipulated during the application of the plaster and held in the required position until the cast is firmly set.

There are numerous spare parts and additions to standard plaster theatre equipment which are used only occasionally, and these must be carefully stored to prevent rusting. They are chiefly of metal, and a polish with a greasy cloth is sufficient to prevent the steel or chromium plate being affected in this way. A tidy room is essential, and cupboards are required for storage according to the number and sizes of the articles concerned.

A plain wooden bench or table is in many instances preferable to an operating table for easy application of lower-limb plasters and for the making of plaster beds. The woodwork can be scrubbed after use, and an ingenious carpenter can make useful fittings for the table which are not found in the catalogues. A convenient height is about thirty inches, and the length comparable with that of an ordinary examination couch.





FIG 3 —The tearing of plaster muslin Each bandage is torn separately to avoid pulling of threads (*Top*)

FIG. 4.—Fraying the edge of a bandage Three strands of cotton are removed from each side to prevent odd threads from becoming loose during the application of a plaster. (*Bottom*)

together with the rough edges, will produce ridges in the cast. The ridges may cause constriction of the circulation if they occur in a full turn of bandage, or they may cause pressure sores, particularly with an unpadded plaster.

the British Pharmaceutical Codex are alcohol, citric acid, dextrin, acacia and glue, but the one most commonly used is borax. Setting is accelerated by the addition of salt or alum. Plaster powder should be stored in closed containers for the best results to be obtained. It is supplied to hospitals in bags of one hundredweight, for surgical and dental use only, being of very fine quality in comparison with that obtainable for other purposes.

PLASTER BANDAGES

The secret of success in plastering very often depends on the quality of the bandages available A poorly made bandage is difficult to use and produces an inferior support. The basis of a bandage is muslin specially prepared to form a stiffened, loosely woven fabric. Its functions are to hold the powder in an even distribution and give strength to the cast. It may be compared with the iron bars in reinforced concrete. 'Plaster' muslin is supplied in sheets twelve yards in length and one yard in width, or in bandage form of the same length, widths varying from two to eight inches. Lengths can be cut from these standard supplies to suit the needs of those who use them. Some useful sizes are:

Six inches by six yards.
Four inches by four yards.
Four inches by six yards.
Three inches by three yards
Two inches by two yards.

And for small finger bandages:

One inch by one yard.
One inch by eighteen inches

Bandages eight inches wide are used in some hospitals, but are difficult to handle without assistance

If the bandages are prepared from sheet muslin, they must be measured half an inch wider than the width required and torn separately and carefully (Fig 3), otherwise many threads will be pulled and an unshapely bandage with a rough, taut edge will result. The extra width is needed to allow for fraying the three outer strands of cotton from each side of the bandage (Fig. 4) before rolling it up loosely. A bandage which is not trimmed in this way will lose odd threads when being used, and these,

three-eighths of an inch in diameter to facilitate the absorption of water from the middle layers as well as the outer layers (Figs. 7, 8, 9 and 10). A larger hole allows plaster cream to escape after



FIG 7—Rolling the end of the bandage to leave a hole ⅜ in diameter in the centre. (*Top*)

FIG 8—Straightening the edges of the bandage during rolling. (*Bottom*)

soaking, and a smaller one prevents sufficient water entering the middle of the bandage to soak the layers completely. A core similar to those used in 'Gypsona' proprietary bandages may be

MAKING OF BANDAGES

A trough or tray is filled with loose plaster powder and the surface levelled lightly. The bandage of the required length is then placed on the powder with the rolled head uppermost and the tail of the bandage nearest to the person preparing it (Fig. 5).





FIG. 5 —Placing the muslin bandage on the plaster powder. *(Top)*
FIG 6 —Plaster powder rubbed into the end of the bandage. *(Bottom)*

The loose end is covered with the powder and held by one hand, and the palm of the other hand is used to smooth in the powder until the mesh is lightly and evenly impregnated (Fig. 6). Pressure is unnecessary and causes an uneven distribution of powder into the mesh. Moreover, bandage-making then becomes tiring. The bandage is rolled straight and a hole left in the centre about

skin is dry and sensitive to plaster. Plaster bandages are stored in large biscuit-tins and plain sheets of brown paper or newspaper are placed between the layers (Fig. 11).



FIG. 11.—Bandages are stored in layers in tins, each layer separated by a sheet of brown paper.

PROPRIETARY BANDAGES are used in many hospitals. They are particularly used for quick-drying light splintage. 'Gypsona' bandages are probably the best known in this country, but there are a number of manufacturers who produce similar types.

The disadvantages of these bandages are that:

1. They are more expensive than home-made ones.
2. Moulding of the plaster round a reduced, unstable fracture, for example, Pott's fracture, is liable to be difficult due to the rapid setting.
3. Beginners find them difficult to use, since, if the bandages are not applied quickly, the roll of bandage sets in the hand during application and this results in waste.
4. They are less durable than home-made bandages and weight-bearing casts need frequent repair and renewal.

used if so desired. The best method of teaching bandage-making is to insist on each member of the staff using his or her own



Fig 9.—Proceeding with the rolling of the bandage (*Top*)
Fig 10.—The finished plaster bandage (*Bottom*)

bandages when plastering In this way defects in rolling are quickly discovered during the application of a cast, and a highly satisfactory bandage is soon produced. Rubber gloves may be worn for the protection of the hands, especially by those whose

CHAPTER III

GENERAL PRINCIPLES OF PLASTERING

PREPARATION

If a plaster cast is to be applied properly, a knowledge of the case history and the requirements of the patient concerned must be obtained from an up-to-date copy of the notes and all current X-ray films. The films of importance should be shown on an illuminator throughout the operation for clear anatomical reference. All requirements for plastering are usually laid out on a large trolley, and from this, articles are taken for the setting of trays or smaller trolleys to meet the needs of both surgeon and patient according to the operation to be done. The plaster trolley is set with the following articles:

Mackintoshes and towels.
Ring cutter, razors and wire cutters.
Scissors, plaster shears and openers.
Electric plaster cutter.
Tape measure.
Sandbags.
Stockinette, plaster wool and orthopaedic felt.
Lead strips.
Scalpels and cobbler's knives.
Plaster bandages
Enamel bowls or pails for soaking bandages.
Fine openwove bandages for applying over wet plaster.
Zinc oxide strapping for binding dry casts.
Calico and domette bandages for bandaging dry plaster shells.

A number of the articles mentioned are shown in Fig. 12.

The patient should be comfortably placed and briefly told what is expected of him for full co-operation. All unnecessary clothing should be removed and parts which need not be exposed covered with blankets, which are folded and enclosed in a cotton bag or sheet. Protective clothing for staff and covers for the patient must always be used irrespective of the extent of the plaster.

LINING AND PADDING

STOCKINETTE is a circular knitted fabric which is used for lining plaster casts. It stretches to the shape of the trunk or limbs and lies evenly but not tightly on the skin. It is supplied in rolls of approximately sixty yards in length, and from one to twelve inches in width.

PLASTER WOOL is wadding which is used for padding plaster casts. It may be obtained bleached or unbleached, and in sheet form from which bandages are torn (not cut) as required, or as bandages in widths of from two to six inches. The wool has a smooth surface which is placed next to the skin, it is non-absorbent, and does not become lumpy when wet plaster is applied over it.

FELT is used for additional protection of bony prominences, and may be plain or adhesive. The plain felt is fixed to the stockinette by odd loose stitches and the adhesive laid on the stockinette where it is needed.

most effective for Colles's fracture, carpal scaphoid fracture, and Bennett's fracture, as padding around the wrist is likely to allow displacement of the fragments. With these exceptions, the padded plaster is advocated for the following reasons:

1. It is more comfortable to the wearer.
2. The padding facilitates painless removal, as the wheel cutter can be used instead of shears.
3. Pressure can be applied at various points with less risk of producing sores.
4. Wedging and 'windows' for observation are two things often necessary in leg plasters, and padding ensures safety in cutting the cast at these points.
5. Reactionary swelling of the tissues after injury is less likely to give trouble as the padding allows some space for expansion of the limb.

There is one marked difference between the padded and unpadded technique. For the unpadded plaster, bandages must be rolled on to the skin *without tension* to avoid constriction of the circulation, and the padded plaster requires *some tension* from the *middle* of the bandage and not the edges, to ensure a properly fitting cast. The basis of an unpadded plaster should be a smooth-surfaced slab to eliminate pressure from folds and creases, but with the padded plaster, bandages can be rolled directly on to the limb, and folds which may occur are less likely to give trouble.

The routine, therefore, is as follows:

The Unpadded Cast

1. Stockinette lining if desired.
2. A closely fitting, smooth slab, as a base.
3. Additional bandages rolled on to the limb *without tension*.
4. Lead strips conveniently laid on the skin before plastering, if splitting of the plaster is required.
5. Clean-shaven skin for the patient's comfort if stockinette is not used and the hair is long and likely to become incorporated in the set plaster.

The Padded Cast

1. Stockinette lining of the correct width.
2. One or two layers of plaster wool with felt rings or strips over bony prominences.

Two assistants are necessary in a plaster room, but if the number can be increased, the efficiency of the unit is greatly improved and the plastering completed in a shorter time.

If X-ray control is needed, the portable machines should be arranged before plastering is commenced, and switches and plugs tested to avoid technical hitches at a crucial moment.

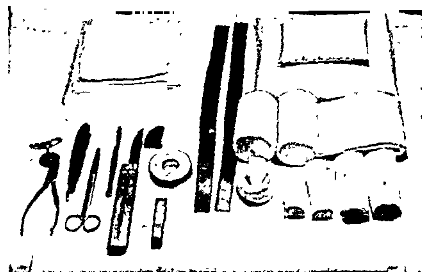


FIG 12 —A selection of articles which may be used daily for the application and trimming of plasters.

Plaster tables should be complete, with all parts oiled and well fitting, and other portable equipment conveniently placed ready for immediate use.

As previously mentioned, a good team-spirit cannot be too highly stressed, with each member of the team fully conversant with his or her special duty. When these points have been checked, the plastering should be easy and straightforward.

METHODS OF PLASTERING

There are two methods of plastering:

1. The unpadded-plaster technique, and
2. The padded-plaster technique.

The latter method is adopted by almost every surgeon because of its many advantages. The unpadded plaster, however, is still the

hastens the setting time. The addition of borax, half a drachm to the pint, delays setting.



FIG 14.—Removing a plaster bandage from the water. Both ends are grasped and pressure is directed towards the centre to remove excess moisture but retain the plaster cream. It is then passed to the operator with the free end ready to apply.

PLASTER SLABS

These are applied from dry slabs, which are prepared in a number of sizes and stored similarly to bandages and soaked as required; or from wet slabs made from bandages at the time of plastering. Ready-made dry slabs are particularly useful when applying large casts in as short a time as is possible. They are made in the same manner as plaster bandages but not rolled. Instead, the bandage is folded neatly backwards and forwards to a specified length and of six to eight layers in thickness. The ends are brought to the middle to make storage convenient and each slab is separated by a layer of brown paper or newspaper. These slabs are soaked in the folded form, removed from the water holding the edges only, and the excess moisture allowed to drip. They are quickly opened out, smoothed on a slab-making surface and then applied immediately to the part to be reinforced. The

3. Plaster bandages applied directly in most cases, *with some tension evenly distributed along the whole length of the limb*, and the edges neatly bound during application.

As a general rule, plaster bandages are placed in a pail or bowl of water, as hot as can be comfortably borne by the plasterer. The water completely covers the bandages, which are left immersed until all bubbling has ceased. Only then are they fully soaked (Fig. 13). Each bandage is removed from the water and



FIG 13 —Soaking a plaster bandage, which is not removed from the water until bubbling has ceased.

firmly held at each end between the thumb and forefinger of both hands. It is then carefully squeezed with pressure directed towards the centre, when excess moisture is removed but the plaster cream retained between the layers (Fig. 14). If a bandage is removed by squeezing in the middle with one hand, a large part of the plaster cream is lost in the bowl, leaving mainly muslin to apply to the patient. As one bandage is removed from the water another is immersed, and if possible one person should accept the responsibility of maintaining the supply throughout the application, with the free end ready to apply. The average setting time is from two to four minutes, depending on whether the cast is padded or unpadded. The unpadded plaster sets more quickly.

In some instances setting time may have to be quickened or delayed. The addition of salt to make a one per cent solution

only disadvantage of this method of slab making is that creases are difficult to eliminate and for this reason a newly made wet slab must always be chosen for direct application to the skin. Wet slabs are made from soaked plaster bandages and can be prepared to any length and with the width varying at each end. The first layer is rolled evenly, the head of the bandage turned back on itself and another layer smoothed without creases in the opposite direction (Fig. 15). This procedure is repeated until the necessary thickness is obtained (Fig. 16), and the slab should be wet and sloppy (Fig. 17). If the slab is for completion to a full plaster later, care must be taken to ensure that the edges are of one thickness of material only. This is produced by shortening the width and length of successive folds by about one-eighth of an inch.



FIG 18 —Making a pleat or tuck in the bandage as it is taken round a limb

APPLICATION OF A PLASTER BANDAGE

In every instance a bandage is rolled closely to the limb. It is usually necessary to pleat one edge of the bandage with successive turns due to the changing contours of the limbs or trunk (Fig. 18). These pleats or tucks are made at different points in the turns to avoid bulk at one part of the plaster. *Twists and folds common in ordinary bandaging must be avoided, as ridges and creases will*

Fig. 15.—Making a slab to a specified length. The width is varied at one end by rolling the bandage outward, and repeating turns in this manner until the necessary width is obtained. (*Top*)

Fig. 16.—Finishing a slab with a wide and narrow end. (*Bottom*)



Fig. 17.—The finished slab, which is wet and sloppy as it rests on the hands.

The part to be plastered is supported by the palm of each hand holding the trunk or limb lightly until the cast is firmly holding the affected part. Sandbags are essential for support of a newly plastered limb, but these should not be used until the plaster is hard enough to rest on them (Fig. 20). A soft plaster will collapse at the site of pressure from the sandbag and set as a flat or indented surface at this point. This will at least make the plaster uncomfortable and may lead to the formation of a nasty pressure sore. Plasters are merely tolerated by the unfortunate people who wear them, and the most comfortable casts are removed with marked relief to the wearer. Always remember that you may at some time be the unfortunate patient, and treat every individual with the care which you would expect from others!

The edges of plasters require trimming, and as far as possible this is done at the time of application. It is sometimes difficult to trim the posterior parts of hip spicas and jackets at this stage without disturbing the patient unduly and producing 'buckling' or cracking of the plaster before it is properly set. A sharp cobbler's knife is used for this purpose, but a skilful hand may find a scalpel much easier and effective. *Nurses should never use a scalpel unless under supervision. One false move may produce a deep wound.* All the edges are rounded and left perfectly smooth. Trimming should facilitate full movement of joints which are meant to be free. Stockinette linings are turned back one inch over the edge and neatly bound either by narrow plaster bandage applied immediately or by adhesive tape applied when the plaster is dry. When the cast is completed, the out-patient may return home with the necessary instructions, and the in-patient to the ward for further supervision by the ward staff.

PLASTER INSTRUCTIONS FOR OUT-PATIENTS

Every patient leaving hospital wearing a plaster is given instructions on the care and possible complications of plaster immobilisation. **These instructions should be both verbal and written.** In the case of patients who have had anaesthetics or who may be unable to understand fully the importance of the instructions, a relative or the person accompanying the patient receives the verbal instructions, and the printed paper or card is placed in a suitable pocket or handbag of the patient, *by the relative*, in order that he or she may have the advice needed until

result, which may be harmful to the tissues lying beneath them. Two-thirds of the previous turn is covered as the bandage is rolled on to the limb. Every turn is smoothed in by one hand as the bandage is changed from one to the other. Failure to do this weakens the completed cast, and instead of one thickness there are several odd layers with small air-spaces between them. Plasters when completed should have a shiny even surface to stand up to wear and tear, but the shiny and

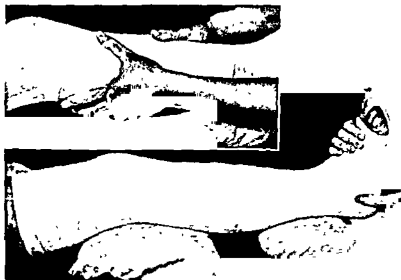


FIG 19—Moulding the cast by light even pressure from the palm and thenar eminence of each hand (*Top*)
FIG. 20—Sandbags in use for support of a newly plastered lower limb. *N B*—The heel should never rest on a sandbag. (*Bottom*)

attractive outer surface should never be one to hide slap-dash application of the previous layers but be typical of the care which has been exercised throughout the operation Moulding of bandages is most important, and for this purpose the palm of the hand and the thenar eminence is used to smooth each layer over bony prominences and soft tissue depressions (Fig. 19). **The fingers should never be used for holding or smoothing. Finger marks show poor workmanship, and indentations are probable sites of pressure sores.**

as removal may cause displacement of a well-reduced fracture. As soon as it is considered safe to allow the patient to return home, the limb is rebandaged lightly, elevation continued, and the attendance as arranged again requested. *On the following day*, X-ray films are taken to show the position of the fracture in plaster, and circulation and movements of the fingers or toes checked. The plaster is completed when the initial swelling has subsided, and daily supervision is essential until the limb shows a normal appearance.

GENERAL COMPLICATIONS AND NURSING CARE OF IN-PATIENTS

Patients who have sustained severe injuries and those who are immobilised in jackets or hip spicas usually require in-patient care. The ward nurses are instructed on the general nursing of particular patients, and in addition to watching for localised swelling, blueness and pressure areas, they have a further responsibility to patients who lie recumbent for several weeks or months and who depend on the nursing staff for every change of position. Such patients, especially those fixed in hip spicas, frequently complain of abdominal distension, with symptoms varying from digestive disturbance to difficulty in micturition and defaecation. If these symptoms are ignored, the consequences may be serious, and complaints of this nature should be reported at once. Some slight adjustment of the cast or even support in different positions usually brings relief. Chest troubles may be apparent very early, and bronchitis or a developing hypostatic pneumonia should be treated immediately. The formation of renal calculi is not very common if the patient is drinking freely. A satisfactory fluid intake is the first step in preventing this.

It is in the case of recumbent patients that pressure sores are most likely to occur, and though the plaster-room staff may be responsible by carelessly padding bony prominences, carelessly moulding the layers or trimming badly, incorrect handling by the ward nurses is often the cause. Pressure sores begin first by pressure, and if the cast has been well applied it is obvious that wrong handling of the still incompletely dry plaster cast has altered the contours, or flattening of a part has resulted from insufficient or badly positioned support on admission to bed A fracture board should always be fixed underneath a hard

the next attendance. Stress must be placed on the fact that the limb may continue to swell for some time, possibly several hours after injury, and that the plaster will not expand to accommodate this. The swelling, therefore, will appear at the extremities, usually in the fingers and toes, and for this reason the limb must *be kept elevated for the first twenty-four hours. The instruction* sheet is printed in bold, black type and may be as follows:

Notice to Patients wearing Plaster Casts

For the first twenty-four hours keep the limb raised as much as possible, keep the arm in the sling provided, and the foot raised on a pillow or cushion protected with a waterproof cover.

Keep the fingers and toes moving.

If any of the following are noticed, report to the Accident Room or Plaster Room, **at once, day or night:**

1. Swelling of the fingers or toes.
2. Blueness of the fingers or toes.
3. 'Pins and needles' in the fingers or toes.
4. Coldness of the fingers or toes.
5. Any real pain in the limb.

Please report to the Plaster Room at (for example, 9 a.m.) next morning.

There is no excuse for failure to have given instructions to a patient It must be a routine procedure for all out-patient work which involves the application or repair of plaster casts.

TREATMENT OF LOCAL COMPLICATIONS

If a patient returns earlier than expected for any of the reasons mentioned, the procedure is as follows:

1. Send for the doctor on duty.
2. Elevate the limb.
3. Encourage movement of the fingers or toes

After examination by the doctor, it may be necessary to split a full plaster, or the bandage covering a shell, to relieve the presenting signs and symptoms of the case concerned. This is done only at the discretion of the doctor, and the signs and symptoms then often disappear within thirty minutes and the limb shows a normal appearance Only when it is absolutely necessary and the symptoms are not relieved by this method is a cast removed,

show increased heat locally, an unpleasant smell and possibly staining with discharge.

The treatment of a suspected plaster sore consists of cutting an observation window over the area, preferably with a motor saw, and applying dressings to the wound as often as is considered necessary. An infected wound is usually dressed daily and the dressings chosen according to the condition of the wound until a simple dry dressing is sufficient protection. After each dressing the window is covered with a thick pad of wool, which is compressed by the covering bandage. The piece of plaster removed, if solid and unstained, should be replaced over the wool before bandaging. This prevents herniation of the tissues occurring through the space, and resulting pressure from the edges of the window, which easily causes blistering. Blisters occurring in this manner or over the site of any severe fracture are snipped to release the fluid, swabbed with sterile gauze, *the skin left stretched but intact*, and a fine antiseptic powder applied to dry the area and prevent infection. Once a window has been cut, the patient is confined to bed until it is again filled in permanently.

REMOVAL OF PLASTERS

Requirements: Saws, plaster shears of different sizes, spreaders, levers or openers, bandage shears (Fig. 21), protective covers for patients and staff, or alternatively mackintosh sheets which can be washed easily when soiled.

Before attempting removal of a plaster the patient is made comfortable and supported along the whole length of the cast. There must be no obstruction in the way of the person removing the cast. Plaster shells secured by openwove bandage are easily removed with the bandage shears, or ordinary scissors in the case of finger shells. Complete finger plasters are soaked in hydrogen peroxide and cut away painlessly after softening. Limb and trunk plasters are bivalved (cut into two halves, usually anterior and posterior portions), the two halves are bandaged together to serve for splintage until after further examination, and are not discarded unless it is clear that they are of no further use. Foot, ankle and leg plasters are removed with the larger shears, hand and arm plasters with the smaller ones. Shears are very difficult to use at first. The blade is placed underneath the plaster but,

mattress, pillows should be placed under flexed parts, and the whole plaster supported in a manner which will prevent cracks at the joints and stress on any particular part of the trunk and limbs. Heels not covered by plaster require ring pads, and so possibly do elbows. The shoulders are usually protected adequately by a flat comfortable pillow.

The best way to dry the cast is to leave it exposed to a warm current of air. Blankets are used to protect exposed parts, but the plaster is never covered. The posterior portion is dried first where possible. Heat cradles may be used, but only under constant supervision and with a minimum of heat.

Two or more people are needed to turn patients in large plasters; pressure is never put on an affected limb during turning, and the patient himself is asked to co-operate and to relax completely to prevent friction and movement inside the plaster.

THE CARE OF A PLASTER CAST

Itching beneath a plaster, especially during hot weather, cannot be avoided, as some skin areas cannot be reached for routine care. In these instances it will be found that patients frequently procure some object or instrument which can be pushed down the plaster to the source of annoyance and so relieve the itching. Rulers, pencils, knitting needles and combs are only a few of the things which have been used. **This practice is dangerous and must be stopped immediately. The risk of fragments breaking off is very great, and these will cause friction, skin abrasion, penetration of the tissues, infection and sores which could have been avoided by proper supervision.**

A complaint of pain underneath a plaster is to be taken to indicate the risk of the formation of a sore, and this should be investigated at once. If the patient has endured discomfort for a few days before reporting it, then a sore almost certainly has developed and, on further examination of the part, will be discovered. Occasionally, there is little pain associated with a sore, and the first signs are shown by the patient's general condition. There is often a rise of temperature for no apparent reason; adults become irritable with loss of appetite, and children are fretful and restless at night. On enquiry, the patient may agree that there was a 'slight burning sensation' previously, but that he did not report it. Examination of the part mentioned may

if possible, *over* the padding. Padding impedes progress and will protect the skin from the blade if left undisturbed. The method of removal is explained to the patient, and instruments are handled with care, but firmly held with each movement. The blade is inserted with the flat smooth surface next to the skin or padding, and the arm with the cutting blade is kept still with all movements carried out by the other arm. This ensures a clean, straight cut, and removes the danger of cutting the skin with points which dig in the tissues when incorrectly handled (Fig. 22).

Arm plasters are bivalved on the outer aspect, avoiding all bony prominences. Leg plasters are bivalved on either side with the cutting curve at the ankle directed beneath the internal malleolus and in front of the external malleolus. Trunk plasters are heavy and are bivalved with the aid of a saw rather than shears. Special care is exercised when removing plasters from children. A child is always apprehensive when a cast is to be removed, and the sight of a plaster cutter is sufficient to make the operation difficult. Removal must be slow, but carried out in complete confidence by one experienced in the art. A pleasant conversation with the child will often allay his fears, and his co-operation will be gained.

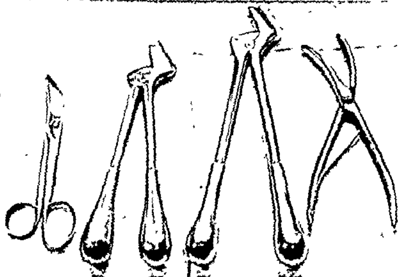
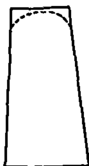


Fig 21 —Bandage shears, Lorenz plaster shears, and openers, used in the removal of plasters.

Fig 22 —The correct and incorrect use of Lorenz plaster shears. B and C, incorrect, D, correct (Hamilton Bailey *Surgery of Modern Warfare.*)

having only two layers of bandage round the finger and flexing with the fingers together is to prevent adjacent digits being forced outward and thus restricting movements. The aim is to immobilise only the part affected and avoid the promotion of further disability by slap-dash and bulky application.



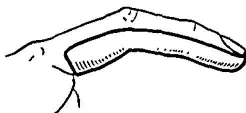


FIG. 24

FIG. 23.—Finger slab trimmed at the narrow end for moulding round the nail.
FIG. 24.—Finger shell in correct position on palmar aspect and leaving the nail exposed.

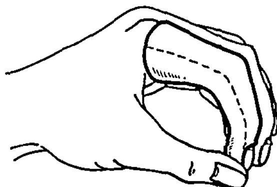


FIG. 25 —Finger shell bandaged. The affected finger is flexed with the others to the functional position and held until the plaster has set.

THUMB SHELLS

The Requirements for a Thumb Shell are:

One plaster bandage, two inches by two yards,
One openwove bandage, two inches wide
for short shells immobilising the terminal phalanx, or
One plaster bandage, three inches by three yards,
One openwove bandage, two inches wide
for long shells immobilising the proximal phalanx and metacarpal.

CHAPTER IV

PLASTERS FOR THE HAND

FINGER shells are sometimes needed for the treatment of injuries of the terminal and middle phalanges, but are not suitable for the treatment of fractures of the proximal phalanges. They should be applied with care and fixed in the functional position of slight flexion, except in the cases of extensor tendon repairs and 'mallet' finger deformities.

FINGER SHELLS

The Requirements for a Finger Shell are·

One plaster bandage, one inch by eighteen inches.
One openwove bandage, one inch wide.

Method of making Shell

Immerse the plaster bandage in warm water, remove excess water by squeezing gently from both sides of the bandage, directing pressure towards the centre, and make a slab extending from the tip of the finger-nail to the proximal skin crease on the palmar surface of the finger The width of the slab should be sufficient to cover two-thirds of the skin surface allowing for dressings Trim the end with scissors for moulding round the tip of the finger as shown in Fig. 23. The wet slab is applied to the palmar surface of the finger to avoid bony prominences and is moulded round the sides, leaving the finger-nail exposed for supervision of circulation (Fig. 24). Bandage the shell in position quickly with two layers of wet openwove bandage, and seal the end with a little plaster cream left over from the making of the slab With all the fingers together, ask the patient to flex them slightly to the functional position. This must be maintained until the plaster is set (Fig. 25)

If the fracture is at or near the terminal or proximal interphalangeal joint, stiffness may result, and hence the necessity for flexing the fingers. **A stiff flexed finger can be used, but a stiff extended finger gets in the way.** The reason for

'MALLET' FINGER PLASTERS

A 'mallet' finger shows a flexion deformity of the terminal interphalangeal joint with hyperextension of the proximal. It is due to forcible flexion of the terminal interphalangeal joint. The extensor tendon is avulsed from its attachment into the base of the terminal phalanx, and there may be a chip of bone torn off with the tendon.

Treatment by fixation in a Plaster of Paris cast for a minimal period of six weeks will produce a satisfactory result in approximately twenty-five per cent of the cases, provided the patient co-operates and keeps the plaster in good condition for the whole



FIG 29 —The short mallet finger plaster, held by the patient until it is set.

period. On the whole, the results of fixation are very disappointing, twenty-five per cent of the cases show no improvement and a fixed flexion deformity, and fifty per cent show partial recovery with limited active but full passive extension.

The usual plaster for 'mallet' finger extends from the tip of the finger-nail to the web of the finger and is made from one two-inch bandage, half the length being used to make an anterior shell and the remainder to complete the cast. The terminal interphalangeal joint is hyperextended and the proximal one fully flexed whilst the plaster is wet, and the whole is held until firmly set. Full flexion of the proximal interphalangeal joint is essential. The patient can often maintain the position himself by holding the tip of the affected finger against the tip of the thumb (Fig. 29).

A better fixation is obtained in a plaster which includes the metacarpo-phalangeal joint, held in flexion, but which allows free

When applying a shell to the thumb a different technique is needed, as shown in Figs. 26, 27 and 28. The trimmed edge of the shell is placed on the dorsum of the thumb to leave the nail exposed, and the rest is moulded round the tip and thenar eminence. A long shell is also moulded to the wrist, which should be held in functional position The position in which the thumb is fixed depends on the injury. Unless otherwise stated, the shell is applied with the thumb in functional position, bandaged loosely and flexed slightly whilst the plaster is still wet.

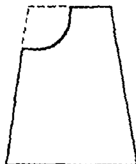


FIG 26—The trimming of a shell to fit round a thumb nail.



FIG. 27

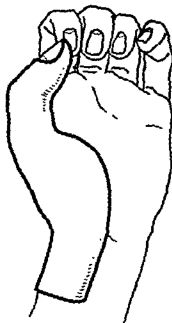


FIG. 28

FIG 27—The short thumb shell for fracture of the terminal phalanx.

FIG. 28—The long thumb shell for fractures of the proximal phalanx and metacarpal.

Finger and thumb plasters are rarely completed, as support from a shell is usually adequate The 'mallet' finger plaster, however, is the exception.

bandage is quickly applied, starting round the tip of the finger. Three turns of this bandage round the finger secure the slabs. The metacarpo-phalangeal and proximal interphalangeal joints are then flexed. The bandage is carried diagonally across the dorsum of the base of the proximal phalanx on to the back of the hand (Fig. 32) and a 'figure-of-eight' turn applied around the

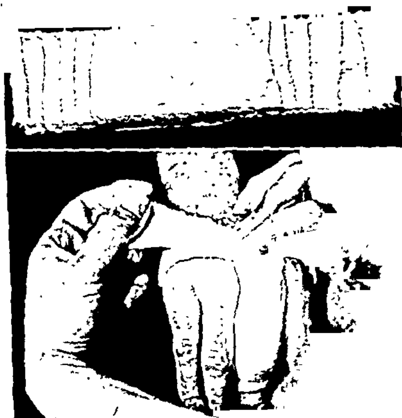


Fig. 31.—The finished slab (*Top*)
Fig 32 —The finishing bandage is taken obliquely across the dorsum of the base of the proximal phalanx to the back of the hand. (*Bottom*)

hand and affected finger. The bandage is continued round the hand for several turns until it is finished. The plaster applied round the hand should lie proximal to the knuckles and cross the palm at the level of the palmar skin creases, passing between the thumb and index finger, so that it does not impede the movement of the other metacarpo-phalangeal joints, nor that of the thumb. During this operation each turn is applied loosely; each layer is

movement of all other digits and almost full use of the hand Even in this type of plaster, a fair proportion of patients are able to do their usual work with little inconvenience or handicap. The plaster is, however, rather difficult to apply. The need for speed and accuracy cannot be too strongly emphasised, as success of the immobilisation depends entirely on these two factors. Two plaster bandages, two inches by two yards, are required and applied as follows:

One bandage is immersed and from it two slabs are made, the first approximately five inches in length and the other four inches in length. This example is applicable to the fixation of the middle and ring fingers, which are longer and also require more skill than do plasters for the index and little fingers. The slabs are prepared wet and sloppy and the second bandage is immersed whilst these are being made. The patient is seated with the elbow resting

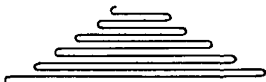


FIG 30—A diagrammatic sketch to show how a slab is formed in layers from the base with maximal thickness at a point where it is needed

on a table. The five-inch slab is applied anteriorly from the tip of the finger-nail to the palmar crease of the hand, and the four-inch slab is applied to the dorsum, embracing the anterior shell on each side and extending from the base of the nail to just over the metacarpal head The slabs may have to be slit about a quarter of an inch on either side for moulding round the base of the finger. It is obvious that in order to maintain the final position extra reinforcement is needed over the metacarpo-phalangeal and proximal interphalangeal joints which are the points of stress. The slabs are prepared with the maximum thickness at these points as illustrated in Figs. 30 and 31. The first figure shows how the thickness is obtained in layers during the fashioning, and the second illustrates the finished appearance when looking down on the slab. The initial layers are applied next to the skin as they are smoother and have not been folded back. The wet slabs overlap, giving the maximum thickness needed between the fingers without causing bulk. The second

If plasters and splints have to be renewed periodically, it is important to maintain the hyperextension at the distal joint during and after removal and until the new support is fixed. Failure to do this will probably result in any fine attachments being torn away, and treatment will have to be commenced *ab initio* with no guarantee of final success.



FIGS. 34, 35.—The long mallet finger plaster applied to the index finger.

FRACTURES OF THE PROXIMAL PHALANX OF THE FINGER

Simple crack fractures of the proximal phalanges are often treated in elastic adhesive strapping so that free function of the hand is retained from the first. Fractures with angular and rotational deformities are reduced and fixed in plaster under a general anaesthetic. The reduction can usually be held by a posterior plaster shell which is completed to a full cast when a good position is confirmed by X-ray and the initial swelling has subsided. One plaster bandage, four inches by four yards, is required for the shell, and a bandage of the same size is used for completion later. If a full plaster is required immediately, a bandage of four inches by four yards and one of three inches by three yards produces a plaster of adequate strength, as these are applied together in a wet state and form a solid mass.

rubbed into the slab and previous turn very firmly, and the edges are smoothed while still wet. The plaster should still be soft when finished, if applied quickly, and easy to mould to the final requirements. The hand is held firmly, all fingers flexed together as fully as possible at the proximal interphalangeal and metacarpo-phalangeal joints, and in this position the affected terminal interphalangeal joint is hyperextended easily by slight upward pressure on the finger-tip. Setting time is from two to three minutes and the plaster must be held until it is complete (Fig. 33).



FIG. 33.—The appearance of the mallet finger plaster which includes the metacarpo-phalangeal joint.

Figs. 34 and 35 show the same plaster applied to the index finger.

Though this plaster may be considered unorthodox, the results are so encouraging that it is well worth trying. Circulation is checked by pressing on the nail, when blanching should occur. When pressure is released, the colour returns immediately if the blood supply has not been constricted. The patient is told to make this simple check daily and to return to hospital at once if a change in colour is observed.

Sometimes a 'mallet' finger deformity is complicated by a wound. In this case, padded metal splintage applied anteriorly and held in good position by adhesive tape is probably the best method of treatment. The splint is retained until the wound is well healed and need not be removed for change of dressings. A plaster cast is applied as soon as it is considered safe to do so and retained for as long as required.

With a four-inch plaster bandage make two wet slabs of the necessary length, the two ends measuring four inches and six inches wide. Trim as shown in Figs. 36 and 37. Fig. 36 is the shell for the dorsum and Fig. 37 that for the palmar surface. Place the hand in the functional position with the wrist in 30° of dorsiflexion and the metacarpo-phalangeal joints in not less than 45° of flexion. Apply the palmar slab first. The dorsal slab overlaps at the proximal phalanx and the ulnar border of the hand. Mould each together very carefully, still maintaining the position. The two slabs form an almost complete cast. Immerse the three-inch bandage and apply quickly over the slabs; and

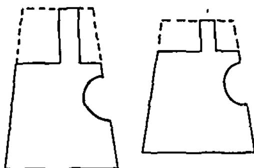


Fig. 36.—Pattern of posterior slab for a proximal phalanx plaster.
Fig. 37.—Pattern of anterior slab for a proximal phalanx plaster.

at this stage scissors are required for neatness in turns of the bandage. Commence the three-inch bandage obliquely on the dorsum of the hand and cut one inch up the width on the radial border to bring two inches of bandage between the affected and the adjacent finger. The bandage now lies on the palmar surface of the hand. Make another cut in the same manner one inch from the first, and bring the bandage between the fingers on the opposite side and back on to the dorsum of the affected finger. Repeat the finger turn once, mould well and carry the bandage down on to the dorsum of the hand. Then bring all the fingers together in flexion. There is now sufficient thickness to hold the proximal phalanx firmly, and there is no bulk of plaster between the fingers to restrict movements of those unaffected. Continue the bandage round the hand, passing *the first turn* between the thumb and forefinger and cutting two inches into the proximal

Method of applying Shell

The length is measured from the distal end of the middle phalanx to three inches above the wrist with the hand in the functional position. The four inches by four yards bandage is immersed and a slab made of the required length measuring four inches in width at one end and shaped to measure six inches at the other. In its wet state and before it is applied, the slab is trimmed with scissors as shown in Fig. 36, cutting more from one side than the other according to which finger is to be immobilised. This ensures correct fitting round the finger and thumb and no further trimming is required after application (fractures of the fifth proximal phalanx are fixed in a simple shell applied to the ulnar border of the hand and round the finger without trimming) The slab is applied to the dorsum of the hand and bandaged in position with a two-inch wet openwove bandage as follows.

Two turns round the fracture site, and *an extra turn round an adjacent digit to give lateral splintage where angulation and rotation of the fragments are likely to recur.* Continue the bandage round the hand and wrist until the shell is held firmly but not tightly in place. The hand is then supported with the wrist in the functional position, that is 30° of dorsiflexion, and the fingers flexed from the metacarpo-phalangeal joints until the plaster has set.

When the shell is ready for completion, another plaster bandage, four inches by four yards, is soaked and the openwove bandage removed while this is being done. The bandage is applied over the shell and must be wet and sloppy to adhere properly. Each turn is well and evenly moulded into the palm, wrist, round the affected finger and between the thumb and forefinger, and it is usually necessary to cut into the width of the bandage for moulding round these parts. Details of where to cut are given in the paragraph concerning the application of a full plaster. Two turns round the fracture site are adequate, a further turn round an adjacent finger being omitted as by this time the fracture is well fixed in position by the shell and unlikely to move.

Full Plaster without Reduction

The technique differs in this instance and produces a cast of even thickness on both palmar and dorsal surfaces of the hand and wrist. The method is as follows:

The following points must be kept in mind during application:

1. Avoid rotation at the fracture site by keeping the end of the finger pointing to the scaphoid tubercle.
2. If angulation at the fracture site is such that proper position is difficult to maintain, always use an adjacent finger for side splintage, separating the two skin surfaces with a thin layer of gauze or wool and plastering the two together.

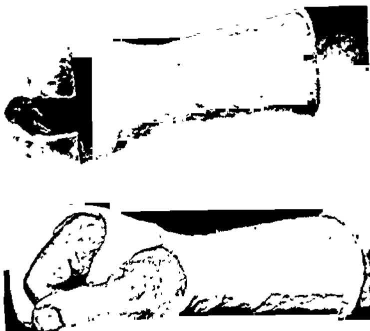


FIG. 39.—The proximal phalanx plaster looking on to the dorsum of the hand. (*Top*)
FIG 40 —Lateral view of the proximal phalanx plaster. (*Bottom*)

FRACTURES OF THE METACARPALS

Simple crack fractures of the metacarpal shafts are successfully treated in a firm strapping support similar to that used for crack fractures of the proximal phalanges. If, however, there is marked displacement and reduction is necessary, or if more than one metacarpal is fractured, a plaster is often applied for adequate support. The method of application is the same as for a proximal phalanx plaster, but as the immobilisation extends from the

border to do this neatly with a minimum of plaster at this point, thus allowing free movement of the thumb (Fig. 38). *The second turn* is brought loosely round into the palm, moulded well to exclude all air bubbles and then again carried between thumb and forefinger as above. *The third turn* is from the dorsum of the hand and round the wrist, and the second and third turns are



FIG. 38 —The completing bandage for the proximal phalanx plaster, cut to pass between the thumb and index finger

then repeated alternately, producing a figure-of-eight, until the bandage is finished. The cast is now approximately one-fifth of an inch in thickness, very light, yet strong when dry, and a most comfortable form of immobilisation. In making turns it may be found that the bandage covers parts which should be free. If this excess is not sufficiently wet to be loosely moulded in, it should be cut off with scissors or a knife to produce a finished plaster as in Figs. 39 and 40 This is a difficult plaster to apply, but it becomes easier with practice.

BENNETT'S FRACTURE

Stave of the Thumb (Bennett, 1877)

This is a fracture-dislocation of the base of the thumb metacarpal caused by violence acting through its long axis. If unreduced, it is likely to cause some loss of function. Treatment consists in reduction of the fracture under a local or general anaesthetic and the application of a full, split plaster cast, which extends from the metacarpal heads to mid-forearm and includes the proximal phalanx of the affected thumb. There are various methods of reduction and the plaster is applied accordingly. In one method, an extension is made from strapping, collodion or mastic varnish, or a pulp space pin fixed to the terminal phalanx. The extension and abduction are maintained after manipulation by fixation to a Cramer wire cage, suitably padded over the styloid processes of the radius and ulna and incorporated in the plaster bandages, which are rolled loosely over the hand and fracture site to hold the abduction and prevent redisplacement.

The disadvantages of this method are:

1. At least two assistants are required by the operator.
2. The plaster cannot be applied neatly and comfortably.
3. The patient suffers considerable discomfort from the extension though the actual fracture is comparatively painless.
4. If a pulp space pin is used, there is a danger of sepsis.

For these reasons, the use of this method in many of the larger hospitals is met with disapproval. However, the details are given as follows:

The extension is fixed to the thumb. Two three-inch plaster bandages are then applied quickly round the thumb and hand. Felt pads, three inches by one and a half inches, are next placed above the wrist on the radial and ulnar borders of the forearm. The Cramer wire cage, about thirty inches in length and one inch or two inches in width, is then positioned over the felt, and the whole incorporated in a four-inch plaster bandage from the wrist to mid-forearm. The cage is bent to shape when the plaster is firm and the extension tapes are fixed to the appropriate 'rung' with the thumb in abduction.

A better and simpler method and one in which reduction is properly maintained without extension apparatus is as follows:

The surgeon 'rehearses' the reduction before the plaster is

proximal interphalangeal joint of the corresponding finger to the mid-forearm, as in Figs. 41 and 42, and a greater area has to be covered, an additional three-inch or four-inch bandage is needed to give a uniform thickness to the cast. Fractures of the metacarpal heads are not uncommon and very often have to be reduced under general anaesthesia followed by a plaster shell to hold the reduction.

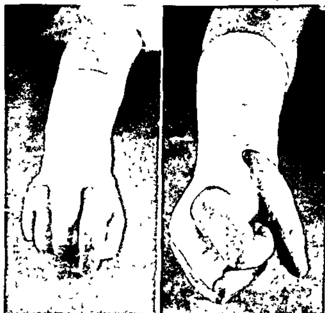


FIG. 41 FIG. 42

FIG 41 —The metacarpal plaster seen from the dorsum.
FIG 42 —Lateral view of the metacarpal plaster.

A fifth metacarpal neck fracture is frequently seen in a fracture clinic, and is the typical injury sustained in a fight when clenched fists are used. A simple shell is applied to the ulnar border of the wrist, hand and little finger without trimming, and the metacarpo-phalangeal joint is held in full flexion with upward pressure on the finger until the shell is firmly set. These fractures are often accompanied by gross swelling and it is usually impossible to complete the shell till several days after injury.

Completion is carried out in the manner described for the previous plaster and the cast is retained until union is sound.

CHAPTER V

PLASTERS FOR THE WRIST

THE CARPAL SCAPHOID PLASTER

When the scaphoid is fractured, the patient may be reluctant to dorsiflex the wrist because of pain, and there is a tendency for him to rotate the forearm and abduct the thumb during the application of a plaster. The elbow should rest comfortably on a table covered by a mackintosh as the bandages are rolled on to the limb. The hand is placed in radial deviation with some dorsiflexion of the wrist to bring together and lock the two fragments of the scaphoid. The thumb and forefinger are placed in apposition, thus affording a firm grip when the hand is in use, and the forearm is held in neutral rotation so that the arm extends comfortably (Fig. 44). Padding is not used, and as the plaster is put on next to the skin, the forearm should be shaved for the patient's comfort.

Bandages required are:

One of two inches by two yards,
Two of three inches by three yards, and
One of four inches by four yards.

The two-inch and one three-inch bandage are soaked together. With the two-inch bandage a slab is made for the thumb to extend from the base of the distal phalanx to one inch above the wrist on the radial side. This is shaped to measure two inches at the distal end and four inches at the other. The three-inch bandage makes an anterior slab which extends from the palmar skin crease to the elbow and allows free flexion of the fingers. These slabs are applied in this order and carefully moulded together. A satisfactory shell is now holding the wrist and is the basis of the finished cast. The second three-inch bandage is immersed as the slabs are prepared and is used for the next stage. The four-inch bandage is left to soak when the three-inch one is removed from the water. Starting from the ulnar border on the palmar side, a full turn is made round the wrist. The bandage is then carried over the dorsum of the hand to the

applied. The wrist is held for countertraction and the thumb extended with gentle traction. The subluxation is then corrected by upward and inward pressure over the fracture site and the metacarpal abducted to lock the reduction. Once the 'feel' of this has been achieved, a wet plaster is applied and the whole operation repeated. The reason for this procedure is that the operator cannot maintain the correction while the plaster is applied and the subluxation quickly recurs. Three plaster bandages, three inches by three yards, are required, and a piece of adhesive felt a quarter of an inch thick and cut to the size of a



FIG 43.—A plaster applied for Bennett's fracture.

penny. The felt is placed over the fracture site to allow harmless light pressure to be made at this point. A very wet slab is made from one bandage and applied from the distal interphalangeal joint to three inches above the wrist. This is quickly followed round the thumb, hand and wrist by the second three-inch bandage, which should also be wet and sloppy. The full width of the bandage is needed between the thumb and forefinger, and is not cut as in other hand plasters. There should now be a sufficient area adequately covered to enable the surgeon to reduce *through* the plaster and have no fear of his efforts proving useless when he releases his pressure The third plaster bandage is applied over the whole, and the plaster is extended to mid-forearm. Wet edges should be smoothed with the fingers during the application and the finished cast should appear smooth and effective as in Fig 43.

described in a well-fitting and well-cared-for cast should have united in six to eight weeks. Some fractures, however, require six to twelve months' immobilisation with no guarantee of union or unrestricted painless movement even after this period of time.

THE COLLES PLASTER

Colles's fracture is the most common injury to the wrist and is caused by a fall on the outstretched hand with the wrist dorsiflexed. The fracture occurs through the lower end of the radius about one inch from the articular surface. There is impaction and often comminution of the lower radial fragment and this may involve the wrist joint. Backward tilt and dorsal and radial displacement of this fragment occurs, thus producing the typical 'dinner fork' deformity. The ulnar styloid is usually torn off.

Treatment consists in reduction of the fracture under anaesthesia and the application of a posterior plaster shell to hold the position. The shell extends from the metacarpal heads to just below the tip of the olecranon process and embraces the radius and ulna on either side with a one-inch space between the lateral edges of the slab. The base of the thumb metacarpal is always included. A plaster bandage four inches by six yards, or one five inches by five yards, provides a strong and light splint, and a three-inch openwove bandage is used to fix this in position. Scissors are required to trim the slab. A bowl or bucket is filled with hot water so that the bandage can be soaked immediately when required The forearm is measured for the length of the slab to be applied before the operation is commenced. The patient is prepared and a general anaesthetic given. When full muscle relaxation is obtained, the surgeon grasps the hand and an assistant provides countertraction by firmly holding the arm with both hands just above the elbow. The fracture is disimpacted, and as manipulation of the fragments is commenced, the plaster and openwove bandages are placed in the bowl. After soaking, the plaster bandage is taken out, excess moisture squeezed out of it and a slab of the measured length and width is quickly prepared. *A common fault is to make the slab too narrow.* For the average adult arm, the width should be five inches at the distal end widening to seven inches at the proximal. When the slab is

metacarpal heads, round to the palm and well moulded into the slab. It is cut two inches through the width on the proximal border to pass between the forefinger and thumb (Fig. 45). Alternate turns are made round the wrist and hand with this bandage. Three turns round the thumb are made with the *four-inch bandage*, cutting where necessary and *rubbing well in*

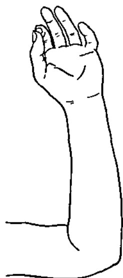
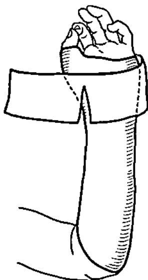


FIG 44.—The position of the hand and wrist for the application of the carpal scaphoid plaster



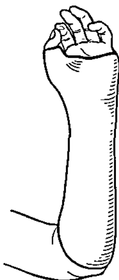


FIG 45.—How to cut the plaster bandage to bring it between the thumb and forefinger.

FIG. 46.—The completed scaphoid plaster.

to the plaster already applied between the thumb and forefinger. The bandage is then brought down over the wrist and rolled evenly from wrist to elbow to form a uniform thickness along the extent of the forearm. The edge of the cast at the elbow should be as thick as that over the hand. The completed plaster is approximately one-eighth of an inch in thickness on the dorsum and one-sixth of an inch on the ventral surface and provides adequate splintage to hold the fracture firmly and yet allow free use of the hand (Fig. 46)

A non-padded plaster is essential Padding is never used, as the risk of non-union of the fracture occurring due to movement inside the plaster is too great An early fracture treated as

in a collar and cuff sling with the elbow in full flexion. Finger movements are encouraged from the start.

A Colles's fracture is often accompanied by considerable swelling. This continues for up to forty-eight hours after injury, and elevation of the limb is needed to prevent circulatory disturbance. For the same reason it is essential to remove rings from the fingers of the affected hand before plastering is commenced, and this applies also to every other injury of the upper limb which requires fixation in Plaster of Paris. The patient is instructed to return *immediately*, day or night, if there are any signs of constriction evidenced by blue and swollen fingers. Should this occur, the gauze bandage must be cut along its whole length between the edges of the plaster shell, the limb elevated and vigorous finger movements encouraged. When the colour of the fingers returns to normal and the movements are satisfactory, the shell is bandaged lightly and the patient is allowed to return home with the limb again supported in a collar and cuff sling. Where there is little or no improvement in the colour, and power of movement has not returned, the doctor on duty requests the removal of the plaster whether the fracture remains in position or slips. Very few plasters need to be removed.

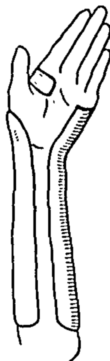


FIG. 49.—The appearance of the Colles slab on the volar aspect of the forearm

If a complete plaster were applied in the first instance, it is almost certain that the patient would have to return to hospital within a few hours of the plaster having been put on. There would be considerable tension in the part of the limb covered by the cast with constriction of the circulation; the fingers would be swollen, blue and painful, and movements severely limited. There is no doubt that the plaster would have to be removed immediately and many a satisfactory reduction would be lost. Removal of the plaster would prove difficult and extremely painful to the patient, and an anaesthetic might be necessary to remove it. For these reasons, surgeons prefer a wide slab which allows some 'give' in case of swelling.

The shell is completed with a four-inch plaster bandage one

made, a small piece is cut out as in Fig. 47 and a portion at the wide end is cut off obliquely. The first trimming allows free movement of the thumb except for the metacarpal, and the second prevents pressure on the antecubital fossa on flexion of the elbow. Turning edges back suggests laziness and produces unsightly bulk. When the shell is finished, the surgeon is usually holding the reduced fracture by a steady pull on three fingers and the thumb. In this position the shell is applied and bound lightly by the wet openwove bandage (Fig. 48). The slab should cover the volar aspect of the wrist and forearm as illustrated in Fig. 49.

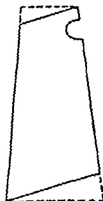


FIG. 47 —Trimming for a Colles slab.

Before the plaster has set, the assistant who has applied the slab can relieve the surgeon of the traction to allow him to mould the fracture into the final correction with the wrist in full pronation, steep ulnar deviation and about 10° palmar flexion. Setting time is approximately two minutes, and when the shell is firm, *additional trimming is made if necessary and the hand placed*

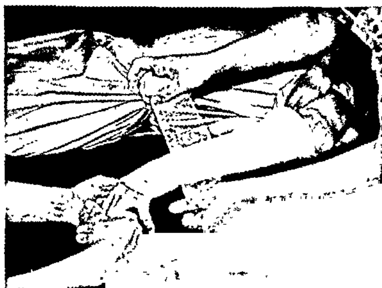


FIG. 48 —Bandaging the Colles slab which covers the radial border of the forearm completely and extends over the ulnar border.

manipulation under anaesthesia, and application of either a posterior or anterior shell with the wrist in dorsiflexion and ulnar deviation. After-treatment is continued in a similar manner to that for Colles's fracture.

DISPLACED SEMILUNAR (LUNATE)

An anterior dislocation of the semilunar is not uncommon, and reduction under general anaesthesia is required. A posterior plaster shell is prepared in the same manner as for Colles's fracture, using a plaster bandage four inches by six yards or five inches by five yards. This is applied with the wrist in steep flexion to prevent re-dislocation and bandaged loosely into position with a three-inch wet openwove bandage. The shell is retained for one week, after which time it is replaced with a full forearm plaster with the wrist in neutral position, and the cast is removed after approximately six weeks. If the scaphoid has been fractured also, open reduction may have to be considered and a scaphoid type of plaster applied, though this is not often necessary. In such instances the plaster is retained until there is sound union of the fractured scaphoid.

THE SHORT 'COCK-UP' PLASTER

This plaster is generally used to keep the wrist at rest in the treatment of inflammatory conditions of the carpus and surrounding tissues. It extends from the metacarpal heads to just below the elbow, allows free use of the fingers and thumb, and holds the wrist in dorsiflexion. Tenosynovitis of the wrist extensor tendons is a common affliction which responds very well to this type of fixation. In some instances where dorsiflexion of the wrist is the only important factor, an anterior shell is adequate. It gives better support to the points of stress at the wrist and palm than a posterior one, and also lies smoothly on the skin surface. It is difficult to apply a posterior shell in this position and at the same time avoid creases occurring over the wrist.

The **anterior 'cock-up' shell** is made from a plaster bandage, four inches by six yards, to extend from the palmar crease to the elbow and to allow full flexion of the elbow. The two ends of the slab measure four inches and five inches respectively, as a wider slab does not properly fit the contours of the anterior aspect of the forearm. The slab is bandaged into position by a three-inch

or two days later. Extra reinforcement is needed over the palm, and this is obtained by making a small square slab of six thicknesses of bandage and applying it to the palm before commencing the circular turns with the remaining length of bandage. The slab is secured by two figure-of-eight turns round the wrist and hand, the bandage is cut to pass between the thumb and forefinger and is then taken along the forearm to the elbow. When the cast is dry, the sling is discarded and the shoulder and elbow are exercised fully several times each day. The plaster is retained for a total period of five weeks and changed after ten or fourteen days if there is fear of the position being lost due to the cast becoming loose when the soft tissues have returned to normal after the initial swelling.

SLIPPED RADIAL EPIPHYSIS

This injury occurs in children between the ages of seven and sixteen years, and is described as the corresponding injury to that of Colles's fracture in an adult.

Treatment consists of reduction of the deformity under general anaesthesia, and immobilisation of the wrist in a plaster shell of the Colles type which is made from a plaster bandage four inches by four yards The routine is the same as for Colles's fracture, the shell being completed into a full cast by a plaster bandage, four inches by four yards, as soon as the initial swelling has subsided. The plaster is retained for three or four weeks, during which time shoulder, elbow and finger movements are practised in their full range

When the plaster is removed, an elastic adhesive strapping bandage is often applied to cover the same area and retained for about a week. This support is not essential, but reminds the child that he or she has suffered an injury which may easily recur if due care is not taken when at this stage full use of the limb is permitted.

SMITH'S FRACTURE

Smith's fracture occurs at the same site as Colles's fracture, but is usually caused by falling on the back of the hand, as opposed to the palm In this fracture the lower radial fragment is displaced anteriorly and tilted forwards, producing what is sometimes known as a 'reversed Colles deformity'. Treatment requires

THE LONG 'COCK-UP' SHELL

A splint which supports the wrist and hand from the finger-tips to beyond the mid-forearm is described as a long 'cock-up' shell. It is useful in certain conditions, for example:

1. *Rheumatoid arthritis*, in which ulnar deviation of the wrist and fingers is corrected by the application of a shell which covers the ulnar border of the hand and is fixed in radial deviation with the fingers slightly flexed. The shell is prepared from a plaster bandage, four inches by six yards, and shaped to measure four inches in width at the distal end and six inches at the other. It is applied to the palmar surface of the hand and wrist and quickly bandaged into position with a wet openwove bandage. The openwove bandage is removed after a few minutes and the slab is trimmed to the shape of the corrected hand and wrist. The thumb is usually free. After drying thoroughly, the splint is used as often as necessary and bandaged with a flannel or domette bandage.

2. *Hemiplegia*, when the spastic hand is supported by a similar slab which holds the wrist dorsiflexed, and the fingers and thumb in almost full extension. An extra plaster bandage, two inches by two yards, is required for the thumb slab. This is applied first and extends from the tip to one inch above the wrist. The long shell is then applied and the two form a complete splint. The shell is held by a wet openwove bandage until 'set', and then removed, trimmed and dried.

This shell may also be ordered for resting a badly swollen hand or to prevent flexion contracture of the fingers following burns.

openwove bandage. A stockinette lining may be used and the *edges turned back before bandaging in position.* If the shell is completed to a full cast at a later date, one four-inch plaster bandage is sufficient to hold it firmly. The plaster bandage is soaked and applied directly to the slab in even circular turns, starting round the wrist and continuing round the hand in four figure-of-eight turns, cutting the bandage to mould between the thumb and forefinger. The remainder of the bandage is then carried evenly along the forearm to the elbow.

If a **complete 'cock-up' or full forearm plaster** is ordered to be applied immediately, the technique varies only in the number and sizes of plaster bandages These are two of four inches by four yards and one of three inches by three yards. The patient is seated with the elbow resting on a table and the forearm is held in neutral rotation with the wrist dorsiflexed. Padding is not usually required and adequate protection of the skin can be assured by application of a well-fitting piece of stockinette and a ring of adhesive felt round the ulnar styloid. A plaster slab is made from the three-inch bandage and applied from the palmar crease of the hand to below the elbow One four-inch bandage is used to complete the cast around the hand and wrist. The stockinette is folded back *between the second and third hand turns* and incorporated in the bandage to produce a smooth edge. The thumb metacarpal is freed by cutting up the width of the bandage where it passes between the thumb and forefinger, and each layer is carefully moulded at the base of the metacarpal to permit full rotation of the thumb. The figure-of-eight hand and wrist turns cross on the ulnar border of the hand The second four-inch bandage completes *the forearm and is commenced at the wrist over the* bandage previously applied. The stockinette at the elbow is turned back and finished neatly in the same manner as that at the metacarpo-phalangeal joints. The cast is firm, light and about one-fifth of an inch in thickness on the anterior surface (Fig. 50).


FIG. 50—The short 'cock-up' plaster

the elbow are completed whilst the fracture is still held. The thumb metacarpal is included; the distal end must be well fitting at the metacarpal heads, so that finger movements are not restricted, and the extreme edges of the plaster must be as thick as that covering the fracture. One layer of wool is applied over a stockinette lining, which extends from the axilla to the knuckles. When the stockinette is turned back, a neat edge is produced. Two four-inch plaster bandages give sufficient support for a child up to six years of age. For an older child, three of the same size are used. One six-inch and two four-inch bandages make a cast of approximately one-sixth of an inch in thickness for an average adult arm. A four-inch bandage is first applied from over the wrist to below the elbow. The six-inch bandage is then applied from the fracture site, over the elbow to the axilla, and its entire length used up in reverse turns from the axilla to below the elbow. The second four-inch bandage completes the hand and wrist, and the final turns are brought to the level of the fracture, where the six-inch bandage commenced. The cast is then of even thickness along the limb. *A full arm sling is always worn with a long arm plaster applied for fractures of the radius and ulna, so that the whole of the forearm is supported.*

Fractures of both bones of the forearm may require manipulation under anaesthesia for satisfactory reduction. There is often considerable reactionary swelling of the limb for up to forty-eight hours after injury, and therefore the fracture is held in a well-fitting and fairly strong shell after reduction, and completed to a full cast as soon as it is considered safe to do so. A four-inch plaster bandage is used for the arm of a small child, one four inches by six yards for an older child, and one six inches by six yards for an adult. The shell extends from the knuckles to the axilla and is wide enough to cover the surface of the limb, leaving about one inch space between the lateral edges. The application of the shell is rather difficult because countertraction must be provided on the arm above the elbow, and whatever is used, it always seems to get in the way of the plasterer. A piece of calico bandage, four inches wide, gives the best pull and the most space, but it is necessary to have a small cotton-wool pad under it to protect the arm. This bandage is held firmly some distance away from the operators and is not removed or the pull relaxed until the slab is quite hard. To ensure a good mould at this point,

CHAPTER VI

PLASTERS FOR THE FOREARM, ELBOW, UPPER ARM AND SHOULDER

THE ABOVE-ELBOW OR LONG ARM PLASTER

This plaster is applied for fractures of the radius and ulna which occur above the level of the radial epiphyseal line. If only one bone is fractured, displacement may be negligible and reduction unnecessary. In this instance, plastering is simple. The patient is seated, and assists by supporting the fingers of the affected arm with the opposite hand and by holding the arm out in front of himself with the elbow at a right angle and the wrist in the functional position. The rotation of the forearm depends entirely on the site and type of the fracture in relationship to the attachments of the muscles in the region of the fracture. In general, fractures of the lower thirds of the radius and ulna are fixed in pronation, of the middle thirds in neutral rotation, and of the upper thirds in supination. This rule is observed to prevent union occurring with the proximal end of the bones strongly supinated and the distal end pronated. If it is ignored, rotation of the forearm after removal of the plaster may be severely impaired. The plaster may be padded or unpadded, according to the request of the surgeon in charge. *A padded cast is desirable, partly because* an initial slab is unnecessary; therefore, the first and successive turns of bandage can be applied with some tension and moulded closely over the fleshy parts of the arm and forearm; and bony prominences, for example the ulnar styloid, olecranon process and epicondyles of the humerus, all of which are subject to pressure, are adequately protected

The rules of plastering must be carefully followed. First the fracture site is immobilised, and then the joints immediately above and below the fracture This allows the surgeon to mould the plaster with pressure on the anterior and posterior aspects of the forearm and to produce an oval-shaped cast to hold the fragments more securely. The parts around the hand and above

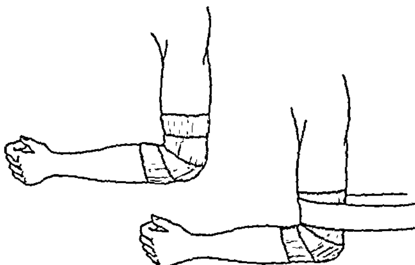


Fig. 51.—Plaster wool padding applied to the elbow before the shell.
Fig. 52.—Calico sling in position for countertraction required in fractures of the forearm.

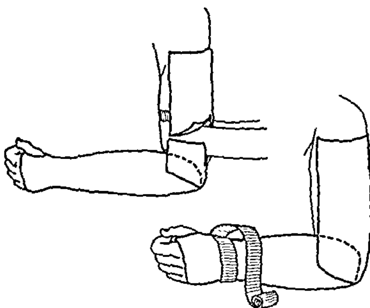


Fig 53.—A 'T' shaped cut in the plaster slab to facilitate a good mould over the calico sling used for countertraction The part of the sling over the medial side does not usually get in the way.
Fig. 54 —The above elbow shell applied to the outer aspect of the arm.

the slab is cut to fit round the bandage, and after operation the ends of the bandage are cut off to leave a small piece of calico incorporated in the plaster. This does not cause any trouble to the patient. The elbow is always protected by a double layer of plaster wool, irrespective of whether the whole arm is padded or not. The lower border of the calico sling is placed over the elbow padding. Figs. 51, 52 and 53 clearly illustrate the whole procedure.

The slab is bandaged loosely with a three-inch or four-inch wet openwove bandage, and the arm is supported in a full arm sling. An X-ray is taken after reduction to confirm a satisfactory position of the fracture. If the limb swells so much that finger movements are limited, the gauze bandage is cut along the whole length immediately and the limb elevated. A loose bandage is applied one hour later if finger movements are then satisfactory and the shell completed at a later date. The bandages required for completion are one four inches by four yards for the small child, one four inches by six yards for the older child, and two four inches by six yards for the adult.

Any arm plaster which incorporates the hand should have a strong reinforcement in the palm as this part is the first to show signs of wear and tear when the hand is being used. A small slab to fit over the palm should be made of approximately six layers from the first twelve inches of the completing bandage. The first of the two bandages used to complete the adult's shell extends from over the hand to the elbow. The second is commenced below the elbow and covers the upper arm. A full arm sling is worn during the whole period of fixation, but is removed for a short period daily for shoulder movements in the full range, and then replaced.

THE ABOVE-ELBOW SHELL FOR FRACTURE OF THE OLECRANON

This is applied with the elbow in whatever position the surgeon orders. There are three methods of treating this fracture but the shell is the same for each:

1. Fracture without Displacement

A padded plaster shell is applied from the axilla to the knuckles with the elbow at right angles.

patient can be seated for the operation and asked to hold the wrist of the affected arm with his opposite hand. In this way, one person can apply the plaster unaided. A measurement is taken from the axilla, round the elbow and outer arm and then over the shoulder to the neckline. The slab is prepared to the required length, six inches in width, and is approximately six layers in thickness. It is then carefully applied to the inner side of the arm with the gamgee square over the end to protect the axilla; brought loosely round the elbow to the outer side and well over the shoulder. Whilst it is still wet and sloppy, the open-wove bandage is quickly and loosely wound round the arm,

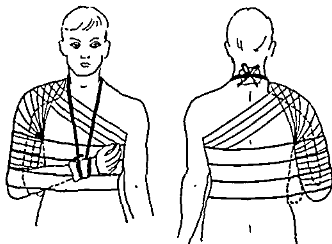


FIG. 55.—The 'U' slab for fracture of the shaft of the humerus, with collar and cuff sling.
FIG. 56.—The 'U' slab seen from behind with gamgee pad between trunk and elbow.

and with each turn the shell is moulded to the arm to form an almost complete cylinder. With successive figure-of-eight turns, the bandage is carried up over the shoulder and under the opposite axilla. When this is completed, the slab should still be fairly wet and the arm usually presents a bowed appearance with the convexity outwards. This is due to bad alignment of the two fragments. Very gently the arm should be extended and abducted at the lower end until a normal clinical picture is obtained, and held in this position for two or three minutes to allow the plaster to set, thereby firmly holding the fracture. At this stage the large gamgee pad is placed between the lower arm and trunk just above the elbow, and the collar and cuff sling is applied to the wrist.

2. **Fracture with Slight Separation**

   A padded plaster shell from axilla to palmar crease with the elbow in extension.

3. **Fracture with Marked Separation**

   Operative correction by suture, screwing, or removal if necessary, and a padded plaster shell.

The slab is made from one plaster bandage, six inches by six yards, and a four-inch openwove bandage is used to hold this in position. The arm is covered with one layer of plaster wool and flexed or extended according to the position desired. A measurement is then taken from the axilla to the metacarpal heads, the bandages are soaked, and a slab of the correct length is rolled to measure six inches in width at one end and eight inches at the other. A small piece is then cut out at the six-inch end for moulding round the thumb.

The right-angled shell is applied to the outer side of the arm and not posteriorly so that pressure over the fracture site is limited; the shell is cut diagonally at the elbow for smooth moulding (Fig. 54), and the whole is bandaged lightly from the knuckles to the axilla. A full arm sling is then applied.

The shell in extension is applied to the anterior aspect of the arm, again to avoid pressure over the olecranon, and bandaged from the palmar crease to the axilla.

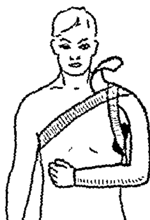
A slab is often applied after operation. The method is the same, but the flexion at the elbow varies according to the stability of the repair

PLASTERS FOR FRACTURES OF THE SHAFT OF THE HUMERUS

There are two recommended methods of immobilising a fracture of the humerus.

The first method is the U-shaped slab which is made from one plaster bandage, six inches by six yards, and held in position with a four-inch openwove bandage An absorbent cotton-wool or gamgee pad about six inches square is needed for the axilla, a collar and cuff sling to support the wrist and forearm, a six-inch domette bandage to fix the arm firmly to the body, and a large gamgee pad to place between the arm and trunk. Reduction of the fracture under anaesthesia is not often necessary, and the

probably the more comfortable to the wearer. First, a small axillary muff is prepared from absorbent cotton-wool placed in the middle of a length of stockinette long enough to cross over the shoulder and tie under the opposite axilla, and then placed under the affected arm. Two plaster bandages are required, one six inches by six yards, the other four inches by six yards, and a full arm sling is needed to support the forearm. From the plaster bandages a slab is prepared to the measurement of four inches beyond the neckline to the wrist, but if it is desirable to include the hand, allowance must be made for this. For the average adult arm, the slab is graduated in width from five inches at one end to nine inches at the other. It is applied to the



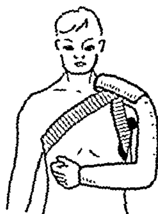


Fig. 59.—*Long arm slab for fracture of the shaft of the humerus, showing crossed ends of stockinette over the shoulder, and the slab about to be folded over.*

Fig. 60.—Plaster slab folded over crossed ends of stockinette from the neckline. The full arm sling and domette bandage are applied over this.

arm with the patient seated as before. Scissors are needed to cut the slab neatly to shape at the elbow. A pad of adhesive felt can be placed over the olecranon before plastering, but this is not necessary if two layers of wool are used to pad the elbow. The narrow end of the shell is placed over the wrist and moulded to the skin surface of the forearm. The shell is then brought round the elbow and up over the shoulder. It is cut diagonally through the width on either side at the elbow and moulded closely to the skin round the arm and over the shoulder. A four-inch wet openwove bandage is quickly applied from the wrist to the axilla, the loose ends of stockinette are neatly crossed over the shoulder

The arm is held slightly abducted and the six-inch domette bandage is wrapped round the arm and chest to complete the fixation as in Figs. 55 and 56. *There should not be any pressure over the olecranon.* Normally, a space is created at this point after bandaging, thus allowing the arm to fall downwards by the force of gravity and assist in the maintenance of the alignment. If there is any doubt in avoiding pressure, it is well to protect the area with a pad of felt before plastering.

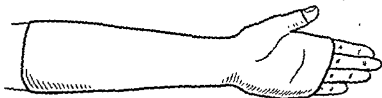


FIG. 57.—Slab for radial nerve (musculo-spiral) palsy: anterior view.

The most common complication associated with this fracture is musculo-spiral nerve palsy. This is indicated by a complete wrist drop and inability to extend the fingers at the metacarpo-phalangeal joints. A separate plaster splint is needed in addition to the U-slab, and is applied as shown in Figs. 57 and 58. The splint is made from a plaster bandage, four inches by six yards, to extend from the proximal interphalangeal joints of the fingers to below the elbow and measures four inches and six inches in width respectively at each end. Another slab for the thumb is made from a bandage two inches by two yards. Both are prepared and applied together to form a complete palmar shell, and lightly bound with a three-inch wet openwove bandage. The metacarpo-phalangeal joints are held in extension with the wrist in dorsi-flexion, and the thumb is held in extension and abduction. The plaster is trimmed and worn as a removable splint, and physiotherapy is begun immediately.

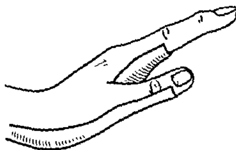


FIG. 58.—Slab for radial nerve (musculo-spiral) palsy. lateral view

The second method of fixation of the fractured humerus is

but with the aid of a suitable rest for the head and upper dorsal spine, two assistants and the operator can apply the plaster without difficulty. One assistant holds the arm in the corrected position, keeping the hand in the mid-line so that it can be brought to the mouth when the elbow is freed, and the other supplies wet bandages with a free end as they are needed. The affected arm is held in abduction, the elbow is flexed, and the forearm is placed in mid-rotation with dorsiflexion of the wrist (Fig. 61). A smaller width of sterile stockinette is rolled over the hand, forearm and arm to the shoulder. This is turned back later at the metacarpal heads. Strips of felt, two inches in width and of appropriate length, are applied over the stockinette on each side of the spine and above the iliac crests. Sterile plaster wool rolls are firmly wound round the trunk, over the affected shoulder and along the whole of the arm to the metacarpophalangeal joints. The plaster extends to the iliac crests to ensure complete fixation and balance, and its upper border reaches the neckline on the affected side and the axilla on the other. The hand of the affected arm may be left free, but it is advisable to provide a palmar support by continuing the plaster to the metacarpal heads and cutting away the portion covering the hand just before trimming.

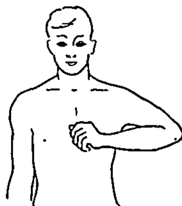


FIG. 61.—The position for applying a shoulder spica.

A common practice in the past has been to maintain abduction of the arm by a strut applied from the elbow to the iliac crest. This is unnecessary, unsightly and most inconvenient to the wearer of the spica. A properly applied plaster gives full support, reasonable comfort and permits the wearing of ordinary clothes with perhaps the arm seams divided and fastened with tapes at intervals. Seams which are neatly divided can easily be stitched together when the spica is discarded, leaving the garments in their original shape.

The plaster bandages needed for the average adult cast are eight of six inches by six yards and five of four inches by four yards. They give a plaster of uniform thickness except for the

and the slab is turned back over the stockinette as in Figs. 59 and 60. The ends are tied under the opposite axilla with a small piece of gamgee separating the knot from the skin. The slab is still soft at this stage and the arm is positioned to appear clinically reduced. Further padding is needed between the affected arm and the trunk before bandaging the whole with a six-inch domette bandage. A full arm sling is applied to take the weight of the forearm and is fixed under the domette bandage.

A 'hanging cast' is occasionally requested where there is considerable overlap of the fragments and apposition is difficult or impossible by manipulation. This is an above-elbow plaster extending from the metacarpal heads to the axilla and covering the point of the shoulder. It is made heavier than the usual plaster by the application of extra bandages, and the object of this is to exert a pull on the lower fragment by gravity and so reduce the overlap. A collar and cuff sling is worn to support the wrist, but the elbow is left free.

In each case, check X-rays are taken and an unsatisfactory position is corrected by re-moulding and re-application of the plaster The plaster is retained for at least six weeks, but when union is apparent clinically and radiologically, the patient is provided with a full arm sling to be worn for one or two weeks and is encouraged to exercise the elbow and shoulder within the limits of the sling until full free movement can be permitted.

THE SHOULDER SPICA

The shoulder spica immobilises the arm in abduction following certain operative procedures, for example, arthrodesis of the shoulder joint. It is often used in the treatment of paralyses of the abductor muscles of the shoulder, but, in these instances, the plaster when dry is converted into a removable padded splint to allow early physiotherapy.

A piece of sterile stockinette to reach from the shoulders to the hips is rolled down over the hips before the operation is commenced. A six- to eight-inch cut is made on each side at the upper end to accommodate the arms When the operation is finished, this is conveniently rolled back to cover the chest before plastering and the opposing cut pieces are quickly but neatly sewn over each shoulder to fit the body like a vest.

After operation, the unconscious patient is unable to co-operate,

of the eighth bandage is well moulded in figure-of-eight fashion over the second and third slabs and then continued over those already applied to the trunk. This completes the plastering, except for that covering the forearm. With two of the four-inch bandages a firm slab is made to extend from the palmar crease to the elbow and give support on the under surface where it is most needed. The slab is fixed with turns over the elbow joining this section firmly to that of the upper arm. Special moulding round

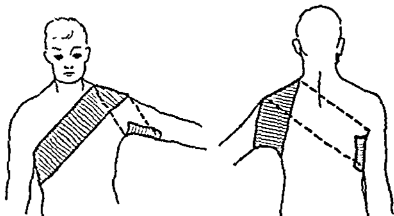


FIG. 64.—The anterior slab for the upper border of the shoulder spica. The posterior slab is applied likewise.
FIG. 65.—The dotted line of the anterior slab corresponds with the level to which the posterior slab is placed.

the thumb is not necessary, because the portion covering the dorsum of the hand is cut away before the edges are trimmed to allow some freedom of the wrist. The stockinette at this end is cut to turn back neatly before binding with strips of two-inch plaster bandage. The shoulder is fixed in a light but effective plaster, and it is wise to allow the patient to return to the ward for recovery from the anaesthetic before any attempt at final trimming and binding is made. If this procedure is left until the next day, the patient can be comfortably seated, in or out of bed, to have rough edges cut away round the upper border and comfortable shaping made at the lower one. The stockinette is turned back one inch, followed by binding with two-inch plaster bandage. The patient is put to bed in recumbency, but as soon as he has recovered from the anaesthetic, sitting upright in bed with the arm supported by pillows is the best position for nursing until the plaster is thoroughly dry.

extra reinforcement under the axilla and upper arm, where a three-eighths of an inch thickness is necessary to hold the weight of the arm satisfactorily. Application is commenced at the axillary level and continued to the hips. Two six-inch bandages are rolled evenly and under slight tension to cover this area. A third six-inch bandage is then applied in figure-of-eight fashion round the chest and affected shoulder, each turn being well rubbed into the previous layer. Three plaster slabs, each made from one six-inch bandage, are then applied quickly, and if another assistant is available to make these whilst the first three bandages are

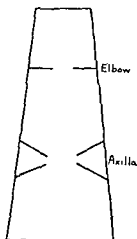


Fig. 62.—Diagram of how to cut the 'under-arm' slab.

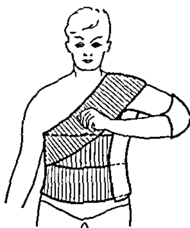


Fig 63.—The 'under-arm' slab applied over wool

being applied, the cast is finished quickly and is possibly stronger because no part of the plaster has set before additional layers have been added The first slab is made to reach from the iliac crest, under the axilla and along the arm to just over the elbow, approximately eight layers of plaster The slab is cut two inches through the width on each side for smooth moulding at the axilla and the elbow, as in Fig. 62. Fig. 63 shows the slab *in situ*. The second and third slabs are identical. Both are of the same length as the first and give further support to the abducted arm, being applied as shown in Figs. 64 and 65. All slabs are six inches wide at each end. When these are fixed in position, the seventh six-inch plaster bandage is commenced over the elbow and finishes the part from the elbow to the shoulder. One turn

CHAPTER VII

PLASTERS FOR THE FOOT AND ANKLE

TOE SHELLS

CLOSED fractures of the toes usually require no treatment other than support in an elastic adhesive strapping spica. Occasionally, however, fractures and soft tissue damage of the great toe can be extensive and very painful and it is often advisable to immobilise such cases in a plaster shell applied over suitable dressings.

The shell is made from a plaster bandage, three inches by three yards, and fixed by a two-inch openwove bandage. It is made to extend from just beyond the terminal phalanx to the base of the metatarsals and one end is widened to about six inches to accommodate the skin surface from the third metatarsal level above and underneath the foot. The wet openwove bandage is applied quickly and the patient is instructed to stand with both feet together to flatten the under surface for easy walking, and to prevent fixation with the toe dorsiflexed (Fig. 67).

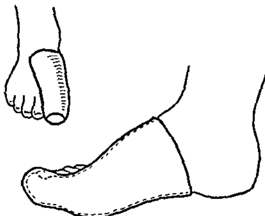


FIG 67.—Toe shell for the hallux, showing open end for observation of the circulation. Hallux shell applied and the appearance before moulding.

The shell can be replaced by another suitable form of support such as a collodion splint or strapping spica any time after the first week, but if the patient is comfortable, and walks well, then it is usually retained for about three weeks. Shells are sometimes used in the treatment of hallux valgus, either as night splints, or post-operatively for two or three weeks. The same method is employed, but instead of the patient standing on the shell, the operator places

The sitting position is used for the application of this plaster without anaesthesia, and for drying. The method employed is the same as that previously described, but two assistants are not needed as the patient can co-operate and support his affected arm

When the plaster is to be used as a removable splint, the edges are trimmed after application, but the plaster is not bound.

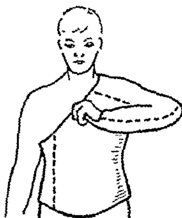


FIG. 66.—The complete shoulder spica showing dotted line where the cast is bivalved for use as a removable splint

The stockinette at the shoulder must be stitched to the body lining to cover the padding completely. The cast is bivalved when dry, preferably with an electric saw, as illustrated by the dotted line in the figure of the finished plaster (Fig. 66). The portion not required is removed, the plaster wool is cut away almost level with the edge of the splint, and the stockinette is trimmed to turn back one inch *The splint is left on the arm* and supported by an assistant until binding is finished. This keeps the stockinette in the position to ensure maximum comfort by leaving the lining as it lies next to the skin

lining of three-inch or four-inch stockinette is rolled over the leg from beyond the toes to the knee. A layer of plaster wool covers this, with an extra layer over the head of the fibula to prevent pressure on the external popliteal nerve, and round the malleoli to lessen the possibility of pressure sores. Whenever possible, an assistant holds the foot in the corrected position, but the plaster can be applied without assistance if a co-operative patient can support his own limb by holding the ends of a strip of four-inch calico bandage, one in each hand, with the centre arranged flat under the forefoot. Another way to obtain maximum dorsiflexion of the foot is to allow the patient to lie face downwards with a small cushion under the knee of the affected leg. The knee is then flexed to beyond the right angle, and the foot is held corrected while the plaster is applied.

For a non-weight-bearing plaster, one plaster bandage, six inches by six yards, and three, four inches by four yards, are sufficient. Two extra bandages, four inches by four yards, are needed for a weight-bearing cast.

The Non-weight-bearing Plaster

One four-inch bandage is quickly applied round the foot from the web of the toes and continued upwards over the ankle to include the fracture site. The six-inch bandage is started over the last turn of the four-inch and covers the leg. The stockinette is turned back neatly below the knee at the level of the tibial tubercle and one and a half inches below the popliteal space to permit free flexion of the knee. This is incorporated into the turns of the six-inch bandage embracing the upper leg. The sole is measured from the metatarsal heads to the turn of the heel, and the second four-inch bandage is used for a slab to reinforce this part of the plaster. The stockinette is turned back to the level of the metatarsal heads under the sole and to the web of the toes on the dorsum. The whole of the foot is then bound firmly and smoothly with the third four-inch bandage, finishing the turns over the ankle. Fig. 68 shows the complete cast.

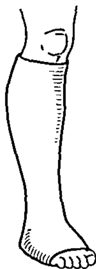


FIG. 68.—The complete below-knee plaster, which allows free movement of the toes.

the thumb between the first and second toes, pushes outward on the proximal phalanx to bring the hallux into a corrected varus, and slightly flexes the metatarso-phalangeal joint. In this manner the deformity is corrected as far as possible.

THE BELOW-KNEE OR SHORT LEG PLASTER

The below-knee plaster supports the lower limb from the web of the toes to below the knee, and is used for injuries or post-operative treatment of the foot and ankle joint. The first method of application is for injuries which do not require manipulation.

The patient is seated on the end of a table, a sandbag is placed under the lower end of the thigh, and the leg hangs loosely from the knee over the edge of the table In this position the knee can be flexed to beyond a right angle to relax the posterior leg muscles, and so make it easier to stretch them at the ankle to bring the foot at a right angle to the leg, or into the position of function. *It is a common fault to immobilise the ankle in some degree of equinus and, if this is maintained for any length of time, re-education after removal of the plaster will prove an arduous and possibly hopeless task.* The reason for this is that the posterior leg muscles are much stronger than the anterior. If the foot is fixed in plantar flexion, the posterior calf muscles are relatively shortened and a contracture may develop which tends to fix the ankle joint in this abnormal position, thus preventing passive dorsiflexion. In addition, the weaker anterior muscles are stretched against the pull of the posterior set, and they become weaker still under the strain and may never regain their normal tone, which is essential for active dorsiflexion. The inevitable result is a drop foot deformity which may be severe and far more disabling than lack of treatment for the injury. The three injuries which for anatomical and functional reasons require the positioning of the foot in equinus are:

1. Fracture of the neck of the talus.
2. Fracture of the os calcis involving the insertion of the tendo Achillis.
3. Rupture of the tendo Achillis treated by suture.

In each case the foot is gradually brought into neutral position as soon as it is considered safe to do so.

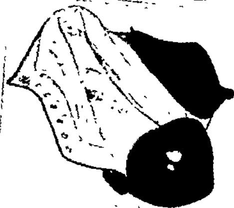
Mackintosh covers are arranged over the thigh and over the opposite leg for protection from splashes of plaster cream. A



Fig. 69.—The rubber-tyre sole which fits over a below-knee walking plaster.



Fig. 70.—The plaster boot with a canvas upper



The Weight-bearing Plaster

The method is similar to that previously described with the first four-inch bandage applied to the foot and ankle and the six-inch bandage round the leg, but the second four-inch bandage further reinforces the ankle and foot, the first turn being started over the last turn of the six-inch and successive turns continued to the toes. The third and fourth four-inch bandages make a thick sole as a single slab, and the fifth binds the stockinette and the sole, finishing as before over the ankle. This type of weight-bearing plaster has two advantages—one for patients and the other for staff:

1. When the plaster is thoroughly dry, a rubber-tyre sole adapted for fastening over the foot is supplied to the patient and walking is commenced with a steady and almost natural gait Moreover, the rubber acts as a cushion and prevents nasty jolts from putting the foot down heavily on the ground (Fig. 69) Alternatively, a boot with a canvas upper which laces from the toes and fits well over a cast may be used (Fig. 70).
2. Either type of protection saves valuable time and material because repairs of the sole are rarely required.

Alternative, but rather out-dated walking appliances are.

(*a*) A plaster heel.
(*b*) A sorbo-rubber heel fixed with strapping.
(*c*) A walking-iron.
(*d*) A leather-faced metal rocker on a wooden base.

In each case the patient tends to walk with an externally rotated foot or a marked limp, due to a feeling of instability caused by the appliance

A Plaster Heel

This should be at least three inches square. It is made from a six-inch plaster bandage, prepared as a slab of its own width and about eighteen inches in length The two long edges are turned back to meet in the centre, leaving a long length three inches wide. This is rolled firmly into a solid mass by turning one end over two inches, making successive turns from this end, squeezing out excess moisture, and moulding flat until the other end is

Turns are repeated in the order described above and illustrated in Figs. 73, 74, 75 and 76. This method secures the heel firmly without increasing the bulk of plaster over the front of the ankle, which would make removal of the plaster difficult. The heel should be soft enough to mould and flatten after application, and

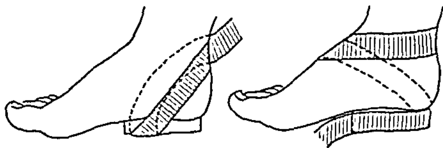


FIG. 73.—Fixing the walking heel, first stage.

FIG. 74.—The bandage continued round the back of the foot, over the front of the ankle and down to the plaster heel.

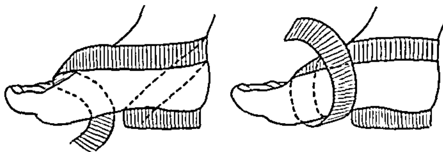


FIG. 75.—Fixing the walking heel, third stage, also showing the first turn of the fourth.

FIG. 76.—The fourth stage of fixing the walking heel. The bandage is then carried round the back of the ankle and down over the medial side of the heel.

a straight wooden splint is ideal for this purpose. The flattening should be made to correspond with the horizontal planes of the ankle and knee joints to promote perfect balance from the commencement of walking, and the height should be about one inch. Unless walking heels are protected, wear and tear will necessitate frequent renewals. In these instances, the whole of the heel and binding bandage is removed completely, a new sole is applied and given time to set reasonably hard before a new heel is fixed.

reached (Fig. 71). The appearance when finished is a block illustrated in Fig. 72. One four-inch plaster bandage is immersed as the heel is being prepared. A flattened side of the finished block is positioned on the sole of the cast corresponding to the position of the malleolus on either side. This ensures correct



FIG. 71.—Making the plaster heel from a slab.

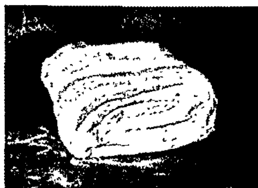
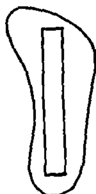


FIG. 72.—The finished heel rolled into a solid block

weight bearing. The four-inch plaster bandage fixes the heel with turns as follows:

1. From the malleolus on one side, round the flattened surface of the heel to the other malleolus, rubbing well in.
2. Round the back of the foot, and over the front of the ankle down to the plaster heel.
3. Round the heel itself, rubbing well in at the joining of the heel with the sole of the plaster.
4. Round the back of the foot and then brought forward over the forefoot.







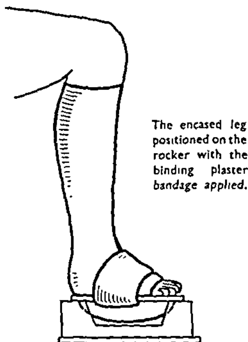


FIG. 79.—The steel and leather rocker with a wooden sole.

posterior slab from the toes to below the knee, and this is cut obliquely through the width at each side for perfect moulding round the *tendo Achillis* and the heel. The slab is cut for moulding as shown in Fig. 80. One four-inch bandage fixes the shell from the toes to above the ankle, and the second from the ankle to below the knee. A light, additional sole is made from six

Sorbo-rubber Pads

A piece of sorbo-rubber three inches square, as for a plaster heel, is secured to the dry plaster with circular turns of two-inch adhesive strapping round the foot and ankle (Fig. 77).

Walking-irons

The horizontal bar separating the side irons is placed one inch from the sole of the plaster, the rubber heel being central between the malleoli. The malleable portions on the side irons are moulded to the shape of the plaster (Fig. 78). A four-inch plaster

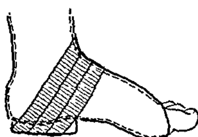


Fig 77.—The sorbo-rubber heel held in place by strapping

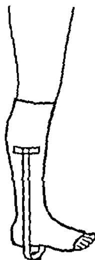


Fig 78.—The walking iron in position before the four-inch plaster bandage is rolled over the side irons to the ankle and reinforced by a second bandage (*Right*)

bandage is immersed and then rubbed well into the cast with the upper end of the iron underneath. A further four-inch bandage is continued down the leg to the ankle and is applied under tension to hold the iron firmly.

Leather-faced Metal Rocker

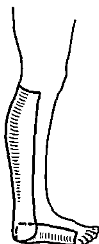
The rocker is placed on the special wooden rest provided for the purpose of fixation and the plastered leg on the rocker base. A four-inch plaster bandage is rolled over the wooden sole and the plaster to secure the two together, and the foot is removed from the rest complete with rocker (Fig. 79).

Unpadded Below-knee Plasters are sometimes used, and although the number of bandages needed is the same, the method of application is different. The six-inch plaster bandage makes a

maintaining the corrected position as far as possible. One four-inch plaster bandage is quickly rolled under slight tension over the foot and ankle from the toes. Fixation is continued by a six-inch plaster bandage applied from the toes to mid-calf and well moulded round the limb. At this point the surgeon grasps the ankle, reduces the dislocation and manipulates the fracture, using both hands to mould to requirements, and, if another assistant is not available, he supports the sole of the foot with his knee or chest, keeps the hands in position after moulding, and holds the leg until this part of the plaster is set. The upper end of the plaster is completed with the remainder of the six-inch bandage whilst this is being done. A further six-inch plaster bandage is started below the knee, and the stockinette is neatly turned back and bound. The bandage is then brought down the leg to overlap the upper portion of that covering the fracture site. By this time the rest of the cast should be set and firmly holding the reduction. The knee can be extended, a sandbag placed under the fracture site, and a light sole made from six layers of a four-inch plaster bandage. This is applied from the metatarsal heads to the turn of the heel. The remainder of the four-inch bandage is used to bind the sole to the plaster.

The soft tissue damage occurring with a Pott's fracture will give rise to considerable swelling, and it may be necessary to split the plaster down the front along its entire length before the patient is allowed to return home. If the plaster is split, it is bound with a wet openwove bandage. Some surgeons do not cut the last half inch at the upper border, so that the cast does not become too loose around the top of the leg. The limb is kept elevated on a pillow until the swelling has subsided, and a split plaster is finished with a four-inch plaster bandage after this time. Weight bearing may not be allowed for some weeks after injury, depending on the stability of the ankle, and many fractures require operative correction by screwing to ensure stability of the joint.

If an unpadded cast is desired, the first six-inch bandage is used as a slab to extend from the knee to the metatarsal heads. It is cut obliquely through the width on either side at the ankle and moulded closely round the tendo Achillis and the heel. A lead strip is placed flat on the front of the leg before the four-inch bandages are applied. The first is rolled evenly round the foot from the metatarsal heads to above the ankle. Tucks are made to


FIG. 80—The below-knee shell cut at the ankle for moulding round the heel.

layers of the third, and after trimming the edges to fit the metatarsal heads, the remainder of the bandage is used to fix the sole in position. *The leg is shaved before the plaster is applied.*

Toe Platforms are used to protect the toes when there is a risk of the patient sustaining further injury by accidentally 'stubbing' the toes against another object. They are also indicated for support of the toes in extensive soft tissue damage. The platform is made by extending the sole a quarter of an inch beyond the toes and curving the edge to the required shape. The toes should rest comfortably on this, *and never be pushed upwards.*

APPLICATION OF A BELOW-KNEE PLASTER FOR THE TREATMENT OF POTT'S FRACTURE

A fracture-dislocation of the ankle, or Pott's fracture, is treated by manipulation of the fracture under general anaesthesia and the application of a below-knee plaster. A strong, wide posterior plaster shell is occasionally used, and completed to a full cast on the following day Some surgeons prefer to have the patient lying recumbent on a suitable table with the affected leg flexed to a right angle at the knee and groin and held by an assistant who also prevents rotation at the fracture site by keeping the patella pointing upwards with a firm hold over the lateral femoral condyle. Others prefer to have the legs hanging loosely over the edge of a table, the injured one supported by a sandbag under the thigh, and to carry out the reduction of the injured ankle sitting on a low stool and using one knee to control dorsiflexion of the foot. With the first method, the surgeon's chest is often used for this purpose, as both hands are required for lateral and medial pressure over the fracture site. The anaesthetic is given, the reduction is 'rehearsed' before plastering, and the final stable position obtained. Dressings over bruised and blistered areas are then neatly applied, followed by a lining of sterile stockinette and one layer of plaster wool. The surgeon holds the leg by the toes,

CHAPTER VIII

PLASTERS FOR THE LOWER LEG AND KNEE

THE ABOVE-KNEE OR LONG LEG PLASTER

THIS plaster may be applied for all fractures of the tibial shaft, and for fractures of the tibial condyles which involve the knee joint. Undisplaced supracondylar fractures of the femur are sometimes treated in this type of plaster, particularly in elderly patients who are not suitable for other methods. The plaster extends from the toes to mid-thigh for injuries below the mid-shaft of the tibia, and from toes to groin for any injury above this level. The patient should be recumbent, and the buttocks raised on a sandbag. The knee, the fracture site, and the foot are held by two assistants if available. A close-fitting layer of stockinette is rolled over the whole length of the leg from the toes. (If the stockinette is wet before it is applied, it fits more closely.) A layer of plaster wool is applied over this. The medial border of the patella is kept in line with the great toe to prevent rotation occurring at the fracture site and union with a rotational deformity. The knee is slightly flexed, and the foot is dorsiflexed to a right angle. In a few instances this results in angulation backwards of the fracture and a slight degree of plantar flexion may have to be accepted until the fracture is 'sticky'. Then the correction of equinus can be made and the plaster changed. The plaster bandages used for the average adult limb are three of six inches by six yards and three of four inches by four yards. These give a thickness of one-fifth of an inch for a non-weight-bearing cast. The weight-bearing cast requires a further two bandages for durability, one six-inch and one four-inch size. The order of application is as follows:

1 One six-inch bandage round the fracture site and the knee joint.
2 One four-inch bandage round the foot and ankle.
3. Two turns of the second six-inch bandage overlap the first below the knee and succeeding turns are then continued over the knee and up the thigh.

facilitate perfect fitting over the contours of the foot and ankle, and moulded into the slab. The final moulding of the fracture site can safely be made at this stage, and whilst it is held, the second four-inch bandage is applied round the leg from over the last turn of the preceding bandage, and the edge at the knee is smoothed. The third bandage forms a light sole of six layers and also binds the sole to the rest of the plaster. When set, the cast is split down the front along the whole length over the lead. The strip is removed and the cut edges brought together. A three-inch wet openwove bandage loosely binds the split cast and is removed if the swelling continues. It is replaced by another when the cast has 'given' further.

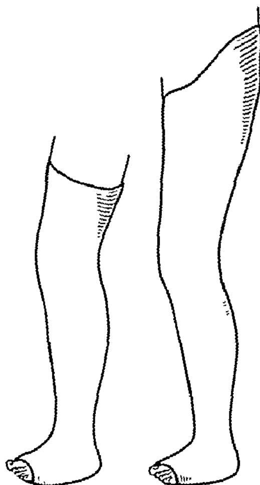


FIG 81 —The above-knee plaster for fractures of the lower third of the tibia.
FIG 82.—The groin to toe plaster for fractures of the middle and upper thirds of the tibia.

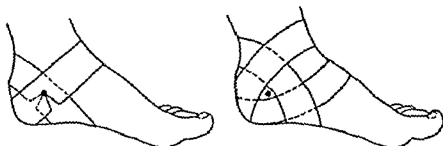


FIG 83 —The correct method of fixing a bandage over a Steinmann's pin
FIG. 84 —Incorrect method of bandaging round a Steinmann's pin

4. The third six-inch bandage is started at the upper border over the last turn of the preceding bandage. The stockinette is turned back, neatly bound, and the bandage is then carried down the thigh and leg to the ankle.
5. The second four-inch bandage is used for the sole as a slab, which is applied from the metatarsal heads to extend over the heel, and is carefully moulded to the cast.
6. The third four-inch bandage completes the plaster, binding on the sole and finishing round the ankle. The stockinette is turned back at the toes to be bound in two or three turns of this bandage.

When the plastering is finished and the cast is 'set' firmly, the limb is supported on sandbags under the knee, the fracture site and above the ankle, until the patient can be safely moved without the risk of cracking the cast at points of stress. Full setting time is about five minutes.

As soon as weight bearing is permitted, a new plaster is applied or the two additional bandages are added to the original. It is better to renew the cast as new wet plaster does not unite firmly with that which is old and dry. The method of application is the same, but the additional six-inch bandage is also applied down the whole length of the leg from groin or mid-thigh to the ankle. The extra four-inch bandage is used with the one for the sole, and when using the two, it is advisable to extend the length to allow cover of the tendo Achillis area, but this portion from the turn of the heel need only be about six layers in thickness. The full thickness is needed under the foot. Cutting of the slab at the heel is sometimes necessary for moulding. The completed plaster is shown in Figs. 81 and 82.

Fractures of the tibial shaft in adults remain in plaster for an average period of about twelve weeks. Further periods of immobilisation depend on the progress of union, and the stability of the limb, as certain types of fracture heal more quickly than others, and the age and general condition of the patient also influence bone healing, which in the tibia tends to be slow.

APPLYING BANDAGES OVER STEINMANN'S PINS

If skeletal traction has been employed in the treatment of lower-limb injuries, plaster bandages may be difficult to apply. It is necessary to fix the bandages closely to the pin, and the best

is necessary, then, because of the risk of exploding inflammable anaesthetic gases, the saw is not to be used, but the plaster is softened with hydrogen peroxide and the cutting done by a plaster knife or scalpel. This is a rather tedious procedure. After making sure that the plaster has been cleanly cut, the



Fig 85.—Bending the limb to make an opening at the point where a 'wedge' is required. (*Top*)

Fig 86 —The 'wedge' inserted in the opening. (*Bottom*)

operator grasps the lower end of the limb with one hand and uses the other to press the upper part of the limb just above the uncut portion of plaster where leverage is needed. Gentle but firm pressure is then used to bend the limb at the fracture site, and in consequence an opening is created where the plaster is cut (Fig 85). When this is large enough, the wedge is inserted in the widest part to fit between the cut edges of the plaster (Fig. 86). It should not be thicker than the plaster or it may cause pressure

way to achieve this is to stretch the bandage over the pin and allow the point and the blunt end to come through the mesh. The bandage is then pushed along the exposed pin and the turn is pleated and rubbed closely into the preceding layers. Alternatively, the bandage is cut half-way through the width and fixed round the pin like a 'key-hole' dressing. Modified figure-of-eight turns are useless, as a space is always created between the pin and the cast no matter how much care is exercised. The space allows movement inside the plaster when traction pulls the limb downward and the cast does not move with it, and also admits infection from the exterior which enters the pin track. See Figs. 83 and 84.

WEDGING A LONG LEG PLASTER

There are certain fractures of the tibia which after manipulation are in a not entirely satisfactory position. Apposition of the fragments may be good, but the general alignment poor because of angulation at the fracture site. If the fracture is unstable, it is often considered unwise to attempt correction of the angulation by further manipulation, because of the risk of losing an otherwise satisfactory reduction.

The padded plaster technique allows for correction to be made with a minimum of disturbance to the limb by 'wedging' at the appropriate point, and an anaesthetic is not usually needed for this to be done. A 'wedge' is a wooden or plaster block, which is inserted into an opening made in the original cast. The cast must be dry before wedging is carried out. The latest of current X-ray films are studied carefully and the degree of correction estimated to place the lower fragment in line with the upper one. When this has been done, the wooden wedge is cut to size or a plaster wedge made from a finger bandage in the form [illegible] ecessary width. [illegible] ve and below the [illegible] plaster just below the fracture to extend round two-thirds of the circumference of the plaster. This line is the guide for cutting where the wedge is required, and its position is determined according to whether the angulation is simply anterior or posterior, medial or lateral, or a combination of two of these. The plaster is cut with an electric saw when anaesthesia is not being used. If an anaesthetic

is used to fill the space created on the opposite side. This method should never be used for an unstable fracture, because it involves the cutting of the whole circumference and increases mobility at the fracture site.

THE PLASTER CYLINDER FOR THE KNEE

Some injuries of the knee do not need fixation of the whole of the limb, and in treating these a padded plaster cylinder may be applied from groin to ankle. The patient lies recumbent as for the application of an above-knee plaster, but in addition to the sandbag placed under the buttocks, the ankle is also supported by a smaller one. The knee is flexed a little, unless full or maximal extension has been specially requested by the surgeon. The contours of the leg do not prevent the cast from slipping slightly downwards, when weight bearing is allowed, and this can be most uncomfortable to the wearer. To overcome this difficulty, it is wise to apply three strips of elastic adhesive bandage to the skin below mid-calf before plastering. These must be one and a half inches wide and about eight inches long. The first strip is placed at the back above the tendo Achillis and the second and third are fixed on either side at the same level. The free ends below the ankle are brought loosely under the heel, to be turned back later and incorporated in the plaster. A length of stockinette is rolled on to the limb from the ankle to the groin, and over this a layer of plaster wool is applied with a double thickness below the knee to prevent pressure over the head of the fibula.

Three plaster bandages, six inches by six yards, are needed for a full plaster. The first is used for a posterior slab, measuring twelve inches in width at the groin and eight inches at the ankle. The slab is applied by two people each holding one end, and is carefully smoothed to the shape of the limb *starting at the back of the knee.* A slab which is fixed first at the groin and ankle is straight and holds the knee *but does not support it.* The second six-inch bandage should be soaking whilst the slab is being prepared. This is used to bandage the slab in circular turns, starting round the knee. From the knee, turns are made up the thigh to the groin and then reversed down the whole of the leg. The shell should be held firmly in position by this bandage. The stockinette is turned back at the groin and ankle, and the free ends of the strips of strapping are brought back with the plain

where it is inserted. Fig. 87 shows the X-ray of a fracture of both leg bones in which valgus angulation was fully corrected by this simple method. If, after X-ray, more or less correction is needed, the wedge is removed and replaced by a larger or smaller one. The plaster is completed by filling the gap on either side of the wedge with a small firm wool pad and applying a sloppy four-inch



FIG 87—The X-ray of a fracture of both leg bones in which valgus angulation was fully corrected by 'wedging' (*Left*) Before wedging (*Right*) After wedging.

plaster bandage evenly round the limb to extend three inches above and below the wedge area, rubbing it well in to the surface of the dry cast.

A second method of wedging is sometimes used. In this a bi-convex portion of plaster is removed from half the circumference to the shape of the space required for the wedge. The other half of the circumference is cut horizontally. The plaster is then bent to bring the separated edges together, and the piece removed

CHAPTER IX

THE HIP SPICA

FIVE types of hip spica are used according to the immobilisation required for respective injuries and operations:

1. The jacket spica.
2. The short walking spica.
3. The single hip spica, which includes the whole of one leg.
4. The double hip spica.
5. Plasters for congenital dislocation of the hip.

1. THE JACKET SPICA

The jacket spica is a combination of the spinal jacket and the short hip spica, and is the plaster used in the treatment of a prolapsed intervertebral disc. It extends from the sterno-clavicular joint to the symphysis pubis in front, and reaches the mid-dorsal region at the back. The painful thigh is included in the cast. The plaster is cut away in front at the groin to allow free flexion of the unaffected thigh, and at the back for toilet purposes, but the trimming at the side must not uncover the level of the greater trochanter of the femur. Ten plaster bandages, six inches by six yards, are required for the average adult spica, and if properly applied, they form a light but effective cast of approximately a quarter of an inch in thickness. The patient is usually in great pain and unable to stand erect without support. He should, therefore, be placed on an orthopaedic table (such as a Hawley table, shown in Fig. 91, or a Watson-Jones table), and supported at his head and shoulders, pelvis and heels. The legs are not abducted, but the affected hip should be slightly flexed. A lining of stockinette is made from one piece which covers the trunk and another narrower piece which fits the thigh. It is advisable to stitch together the overlapping edges of each piece to prevent these from wrinkling and causing unnecessary discomfort to the patient. Felt strips two inches wide are placed above the iliac crests and down either side of the spine, and a

cloth side laid flat on the plaster. The third bandage is started above the ankle and continued to the groin, and the edges are bound in at the groin and ankle. The completed plaster should be comfortable, very light and yet strong enough to be worn for

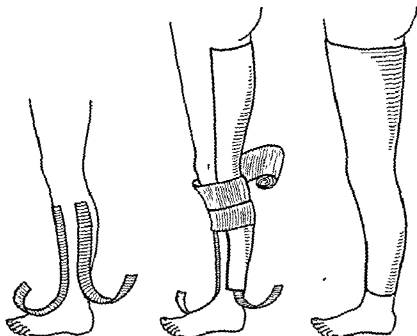


FIG 88.—Elastic adhesive strapping strips applied to the skin before fixing the limb in a plaster cylinder.

FIG. 89.—Completing the posterior slab for a plaster cylinder.

FIG. 90.—The plaster cylinder, finished cast

the recognised period of immobilisation. Correct application ensures this. See Figs. 88, 89 and 90.

N.B.—Swelling of the foot and ankle is not uncommon with this type of plaster, and therefore it is often advisable to apply a strapping spica to the foot and ankle, or a three-inch crêpe bandage before plastering, bringing the upper edge to fit *underneath* the lower border of the plaster.

(*e*) A slab made from one bandage, approximately twenty-four inches long and six inches wide, applied from the opposite hip, above the symphysis pubis, over the groin, and round the back to lie over the skin crease between the buttock and the thigh (Fig. 92).

(*f*) A second slab of the same size applied obliquely from the inner border of the thigh, again over the groin and round the buttocks (Fig. 93).

(*g*) Two figure-of-eight turns over these to fix in position, using the remainder of the bandage from the groin to the knee.

(*h*) Finishing bandage round the buttocks.

(*i*) Finishing bandage round the loins.

(*j*) Finishing bandage round the chest.

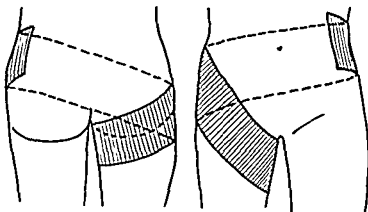


FIG 92.—Fixing the slab to reinforce the hip spica over the skin crease between the buttock and thigh.
FIG. 93.—The second slab to reinforce the groin, applied from the inner border of the thigh.

The plaster should be applied by three persons, two to apply the circular bandages and one to make the slabs and maintain the quick supply of wet bandages with a free end ready to use. The time taken in applying bandages in this way is less than ten minutes. Bandages round the trunk are applied under slight tension; otherwise a loose cast results.

When the plaster is complete, some of the trimming can be done before the patient is returned to bed. The upper border must be shaped well below the axillae to allow free movement of the arms, the stockinette turned back one inch, trimmed, and bound

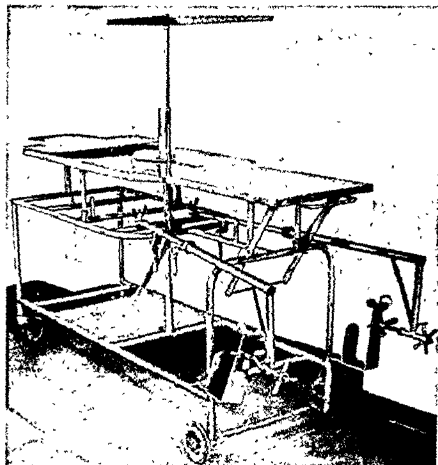


FIG 91 —The Hawley orthopaedic table.

thin layer of plaster wool is rolled over this. The bandages are then soaked in turn, one being immersed as the other is taken out of the water, and applied as follows.

(*a*) Round the chest from axillary level to the lower ribs. In the case of female patients, the bandage is applied from the lower ribs to the axilla to support the breasts.

(*b*) Lower ribs to hips.

(*c*) Round the buttocks, making a figure-of-eight turn round the affected thigh with each layer.

(*d*) From the groin to the knee, turning back the stockinette and neatly finishing the edge at a level which will allow full flexion of the knee.

the breasts. Nine plaster bandages, six inches by six yards, are used as follows:

(*a*) Round the lower ribs to the iliac crests.
(*b*) From the iliac crests round the buttocks.
(*c*) Figure-of-eight turns round the buttocks and the affected thigh.
(*d*) From the groin to the knee as for the jacket spica.
(*e*)
(*f*) } Slabs as for the jacket spica.
(*g*) Two figure-of-eight turns over these, continuing the rest of the bandage to the knee.
(*h*) Finishing bandage round the buttocks.
(*i*) Finishing bandage round the lower ribs.

If the patient is thin and the ribs protrude in front, it is wise to trim the cast as shown by the dotted line in Fig. 95, which illustrates the finished plaster. In this way, full support is maintained and the risk of discomfort and possible pressure sores removed.

3. THE SINGLE HIP SPICA

This spica is suitable for the immobilisation of many fractures of the femoral shaft. The plaster table is used as for the jacket and short hip spicas, but the stockinette for the leg is applied from the toes to the groin, and the plaster wool padding is continued down the leg to the toes. Twelve plaster bandages of six inches by six yards and three of four inches by four yards are required. They are applied by at least two persons in the following order

(*a*) From the level of the fifth rib, round the loins.
(*b*) Round the buttocks from the iliac crests.
(*c*) Figure-of-eight turns round the buttocks and affected thigh.
(*d*) From groin to knee.
(*e*)
(*f*) } Slabs as for jacket spica.
(*g*) Two figure-of-eight turns over these, continuing the rest of the bandage to the knee.
(*h*) Finishing bandage round the lower ribs and loins.
(*i*) Finishing bandage round the buttocks and thigh commencing with two figure-of-eight turns

securely by a two-inch or three-inch plaster bandage. The lower border is trimmed in the manner previously described and bound by another two-inch or three-inch plaster bandage. The binding bandage should be laid loosely over the stockinette and never pulled or twisted, but pleated neatly to fit all curved edges. The back of the plaster is trimmed and bound when the patient is returned to bed. This portion is dried first, exposed to a warm current of air, *and never dried quickly under a heat cradle with no outlet for the air between.* During this time the patient lies face downwards suitably supported by pillows. Turning is carried out within a few hours by two persons, and the plaster is dry in from twenty-four to forty-eight hours, depending on the warmth of the room or ward. Careful nursing is necessary during the whole drying period, for if the plaster 'buckles' or cracks at a point of stress, reinforcement is necessary, thus adding further weight for the patient to bear, and extra work for the plaster-room staff. The patient is allowed up after the drying period, and must then receive instruction in walking, sitting and toilet procedures. He may complain of digestive disturbances and difficulty in breathing. If this occurs, frequent small meals and attention to the bowels usually give relief, but occasionally a small window over the epigastrium may be necessary.

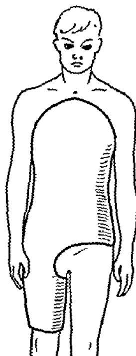


Fig. 94.—The jacket spica (Note that the affected leg is not abducted)

The plaster cast is usually retained for six to twelve weeks, according to the degree of relief of symptoms. See Fig. 94 for the finished cast.

2. THE SHORT WALKING SPICA

This is similar to a jacket spica, the only difference being that the upper border is trimmed to the approximate level of the nipples, or, in the case of a female patient, to a point just under

wool are applied to it if previous padding has become loose and wrinkled necessitating removal.

The four-inch bandages are then applied as follows:

(a) A short posterior slab from above the malleoli to the metatarsal heads, cut down on each side to fit the heel and moulded carefully round the ankle, with the foot in neutral position.
(b) The second bandage to hold the slab.
(c) The third commenced at the toes over the stockinette, which is turned back, and continued to above the ankle.

The completed spica is trimmed at the front and the patient is returned to bed lying face downwards with the plastered foot *outside* the bed to prevent cracking at the ankle. Trimming of the back is done before turning; the plaster is dried in a warm current of air, and careful nursing is again necessary throughout the drying period.

Some patients are allowed up on crutches, wearing the spica, in the later stages of treatment, but before this is commenced the foot must be reinforced to the thickness of a walking-plaster. Two extra plaster bandages, four inches by four yards, are needed, one to make a thick slab from the turn of the heel to the metatarsal heads and the other to fix this in position. The completed plaster is shown in Fig. 96.

4. THE DOUBLE HIP SPICA

The double hip spica is used in the treatment of fractures and osteotomy of the upper end of the femur, and in certain diseases involving the hip joint. The plaster extends to the toes of the affected leg and to the knee of the other.

A stockinette lining is fitted to the trunk and to the unaffected leg and neatly stitched at the groin before the patient is transferred from his bed to the plaster table. If a Thomas splint is in use, it is removed on the plaster table to prevent movement occurring at the fracture site during transference, and the stockinette is then applied to the affected leg. *The fracture site must be firmly supported until properly held by a set plaster.* The head and shoulders rest on a flat pillow over the upper end of the table, the buttocks are brought well down on the pelvic rest until the padded centrepost is as high in the perineum as can be comfortably

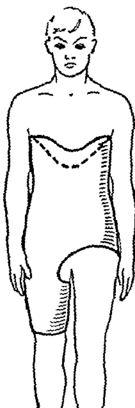


Fig. 95 —The short walking spica The dotted line indicates the level at which the plaster is trimmed, if the patient is thin and has protruding ribs

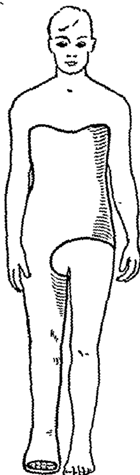


Fig. 96 —The single hip spica

(j) Posterior slab from below the gluteal fold to the ankle.

N B.—If the knee is held in flexion by a bandage, the slab is applied over the bandage supporting the knee.

(k) One bandage to fix this in position by downward circular turns, pleating on the slab, the sling being cut at the lateral edges of the slab, leaving a loose piece underneath which will not cause pressure

(l) One bandage from above the knee to the ankle.

At this stage the bandage holding the foot in position on the table is removed. The foot is supported with dorsiflexion to a right angle by an assistant, and two or three turns of plaster

(*a*) Bandage round the chest.
(*b*) Bandage round the loins.
(*c*) Bandage round the buttocks.
(*d*)
(*e*) } Slabs as in Figs. 92 and 93 applied to the affected side.
(*f*) Bandage to fix the slabs with one figure-of-eight turn, and then continued down to the knee.
(*g*)
(*h*) } Similar slabs to the unaffected side.
(*i*) Bandage to fix these as in (*f*) on the unaffected side.
(*j*) Bandage from the nipple line to the iliac crests.
(*k*) Figure-of-eight turn round the buttocks and unaffected thigh, to be continued as a finishing bandage to the knee, turning back the stockinette and binding it with the last few turns.
(*l*) A long slab to measure from the gluteal fold of the affected leg to just above the malleoli.
(*m*) Bandage, to hold the slab in position from the groin to the ankle.
(*n*) A further bandage to reinforce the leg from mid-thigh to the ankle, making a double turn below the knee where all leg plasters are liable to crack.

In Fig. 98, the sixth plaster bandage (*f*) is being taken in figure-of-eight turns round the calico sling. The sling is cut before the thirteenth bandage (*m*) is applied, leaving a short length of calico between the wool and the plaster. The unaffected thigh is plastered similarly, the sling being cut before the finishing bandage is applied.

A suitably padded rest is placed under the knee before the foot is plastered. This should *not* be done until the bandages have set sufficiently to retain their shape when put on the rest, otherwise flattening of the cast and pressure sores will result. The foot is released, plaster wool applied from the ankle to the toes, and the three four-inch bandages are used in the manner described for enclosing the foot in a single hip spica.

If the plaster bandages are applied correctly and the cast is dried properly, a strut is only necessary in the case of heavy patients and where wide abduction of the legs is needed. A strut is made from one or two plaster bandages, six inches wide, rolled out as a slab of the required length, and the two ends are held

tolerated, and the feet are bandaged securely but not tightly to the foot supports. The knees are slightly flexed, each leg being suspended by a bandage from the two arms attached to the centrepost, or by special padded knee rests which are supplied with another type of table. The top of the table is then lowered. The legs are abducted to the required degree and the abduction arms of the table fixed tightly to avoid displacement of the fracture

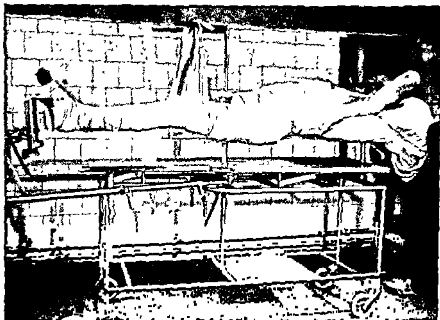


FIG 97.—Patient positioned on Hawley table. The stockinette and plaster wool have been applied and the knees flexed by calico bandage slings attached to the arms from the centrepost The feet are bandaged securely and the top of the table is lowered in readiness for the application of the cast

Positioning is by far the lengthiest and most important procedure and should be done with care. Strips of felt are then applied over the iliac crests and on either side of the spine. These are two inches by nine inches for an adult. Plaster wool is rolled evenly as far down the trunk and legs as is possible in readiness for plastering (Fig 97) The table is protected by mackintosh covers *The position is again checked before the bandages are immersed.*

Fourteen plaster bandages of six inches by six yards and three of four inches by four yards are needed, applied as follows:



Fig. 99 —Method of making cross-bar. (Hamilton Bailey: *Surgery of Modern Warfare.*)



Fig 100 —Cross-bar applied and strengthened (Hamilton Bailey *Surgery of Modern Warfare*)

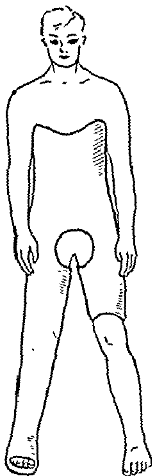


Fig. 101 —The finished double hip spica.

'Frog' Plaster

This extends from round the chest just below axillary level to the ankles. The hips are held in full abduction and external rotation, and the knees in flexion to the right angle. The plaster is applied with the child supported on a hip-prop, specially designed to screw on to the edge of a wooden table, and the head and shoulders rest on a suitably padded support to the height of the pelvic rest. A plain, smooth, wooden box is ideal for this purpose It is turned upside down, the base is covered with three or four layers of gamgee tissue, held in position by a sheet of jaconet cut to shape and fastened at the sides with a number of studs, or strong, round-headed drawing-pins The covering is

and twisted until the middle resembles a rope. The two flat ends are fixed above the knees by figure-of-eight turns of four-inch plaster bandage, with circular turns over the 'rope' to strengthen



FIG. 98 —Figure-of-eight turns round the calico sling to support the thigh firmly before the sling is removed.

it (Figs. 99 and 100). A strut is used to assist in maintaining abduction without putting undue strain on the plaster at the groin *It is not for the convenience of the nursing staff in turning the patient.*

Trimming, binding and drying are done in the same way as that for a single hip spica. The finished spica is shown in Fig. 101.

4. PLASTERS FOR CONGENITAL DISLOCATION OF THE HIP JOINT

The object of a plaster applied for a congenital dislocation of the hip joint is to maintain reduction of the dislocation in whatever position the hip is most stable. Stability of the joint may be maximal in either external or internal rotation and the type of plaster applied depends on this. The 'Frog' plaster is applied when external rotation is needed, and the 'Batchelor' plaster maintains internal rotation

forward over the groins at the front (Fig. 103). The second is brought diagonally from the anterior superior iliac spine on the unaffected side, above the symphysis pubis, over the groin of the affected side, to be continued round the thigh to finish over the knee of the affected leg (Fig. 104). The third is applied exactly as the second, but from the opposite side (Fig. 105).

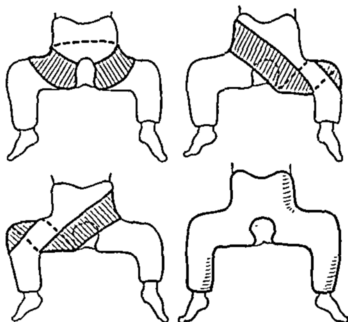


FIG. 103.—Frog plaster, first slab.
FIG. 104.—Frog plaster, second slab.
FIG 105.—Frog plaster, third slab.
FIG. 106 —The finished frog plaster.

One assistant prepares the slabs and passes them in the order mentioned to a second assistant, who fixes them neatly in position and applies circular turns in the following manner:

(*a*) One six-inch bandage, figure-of-eight fashion, to bind all three slabs together round the pelvis with alternate turns round the trunk.

(*b*) A second six-inch bandage round the trunk from the level of the fifth rib to the iliac crests.

(*c*) A third six-inch bandage to complete the affected thigh to below the knee.

(*d*) A fourth six-inch bandage applied to the unaffected thigh to below the knee.

easily washed after use, and can be renewed as often as is necessary (Fig. 102).

When a satisfactory reduction has been achieved, the legs are held by the surgeon, first at the knees until the hips are firmly fixed by the plaster, and then at the ankles while the plaster is completed. Well-fitting stockinette is rolled over the trunk

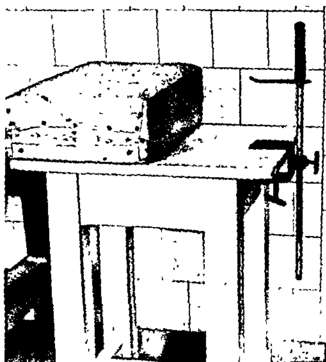


FIG. 102.—Hip-prop and support for use in application of hip spicas to small children.

and legs and neatly stitched to fit smoothly and comfortably at the groins A double layer of plaster wool is applied over the stockinette *after the manipulation* The number of plaster bandages needed depends entirely on the size of the child, but a stout cast is necessary and an average number is four of six inches by six yards and eight of four inches by four yards. Three slabs are applied in positions which will resist stress at the groins, back and knees. Each is made from two four-inch bandages, and the length of each is measured before making. The first is placed over the lower lumbar spine and sacrum and the ends are brought

forward over the groins at the front (Fig. 103). The second is brought diagonally from the anterior superior iliac spine on the unaffected side, above the symphysis pubis, over the groin of the affected side, to be continued round the thigh to finish over the knee of the affected leg (Fig. 104). The third is applied exactly as the second, but from the opposite side (Fig. 105).

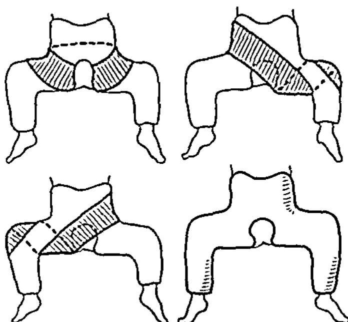


FIG 103.—Frog plaster, first slab.
FIG. 104—Frog plaster, second slab.
FIG. 105.—Frog plaster, third slab.
FIG. 106.—The finished frog plaster.

One assistant prepares the slabs and passes them in the order mentioned to a second assistant, who fixes them neatly in position and applies circular turns in the following manner:

(*a*) One six-inch bandage, figure-of-eight fashion, to bind all three slabs together round the pelvis with alternate turns round the trunk.

(*b*) A second six-inch bandage round the trunk from the level of the fifth rib to the iliac crests.

(*c*) A third six-inch bandage to complete the affected thigh to below the knee.

(*d*) A fourth six-inch bandage applied to the unaffected thigh to below the knee.

(*e*) A four-inch bandage from below the knee to the ankle of the affected leg, turning back the stockinette at the ankle and binding with the lower turns of the bandage.
(*f*) A four-inch bandage applied likewise to the unaffected leg.

Further bandages are added if necessary. The cast is finished, and trimmed at this stage.

A small piece is cut away in a smooth curve at the upper border over the epigastrium. The stockinette is turned back to overlap one inch all round and the edge is then neatly finished with a two-inch plaster bandage. The child is removed from the pelvic rest and placed on mackintosh-protected pillows. The plaster is then trimmed at the groins to the level of the symphysis pubis, the stockinette lining cut to shape and turned over the edge. This is bound by another two-inch plaster bandage. The trimming over the sacral region is finished by turning the child into ventral recumbency on pillows. The head should be supported, and a free air intake assured by constant supervision whilst the anaesthetic is still effective. The plaster cut away should be sufficient to prevent soiling during toilet, but should not allow the buttocks to protrude through the trimmed area, or pressure sores will result The plaster is dried with the child resting on the pillows and turned frequently. A receiver is placed in the cot between the two pillows supporting the legs. When the cast is thoroughly dry, a special nursing frame is used instead of the pillows. It is advisable to bind the lower edges with waterproof adhesive tape, which can be sponged should an accident occur during toilet The finished plaster is shown in Fig. 106 and is retained for a year or more until the reduction is stable. New plasters are applied as required during this period.

'Frog' plasters sometimes have to be changed other than at the routine checking times, because of soiling of the cast with urine. This occurs chiefly in the very young untrained child, and probably at the stage of treatment when the cast is intended to be retained for as long a period as possible. For this reason, a 'Glassona' cast or a resin plaster is often preferred to the ordinary plaster cast, since both are waterproof. 'Glassona' bandages are made from a mixture of glass and cellulose acetate, knitted in stockinette fashion to form a tubular bandage, and are supplied in various widths. They are immersed in a special

solvent for not more than two or three seconds, removed immediately, and excess liquid is allowed to drip back into the bowl. A stockinette lining is necessary. 'Glassona' bandages are applied under tension and stretch easily. Each turn of bandage covers the preceding turn by half its width. Reinforcing slabs are not required, although the bandage can be reversed to form an extra layer over points of stress. In this way a very light durable splintage is obtained. *'Glassona' bandages are inflammable in their wet state, and therefore they should not be applied or dried in the presence of electric sparks or naked flames.* A barrier cream should be used by the operator to protect the hands from the drying effect of the acetone in the solvent, and to allow easier removal of the cellulose acetate from the fingers.

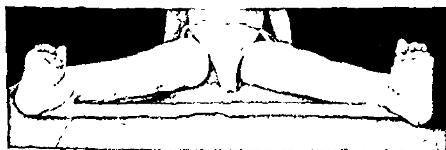


FIG. 107.—The Batchelor plaster in full internal rotation.

'Batchelor' Plaster

A satisfactory reduction in full abduction and internal rotation is held by a 'Batchelor' plaster, which allows free flexion and extension of the hip joints. As the legs are held in the reduced position, plasters are applied to both legs from the groin to the toes. One plaster bandage six inches by six yards and three of four inches by four yards are used for each leg, and are applied in the same manner as for an above-knee plaster for an upper third fracture of the shaft of the tibia. When the plasters have set, a broomstick of the correct length is placed between the legs just above the ankles. It is fixed in this position by a plaster bandage four inches by four yards, rolled firmly round each end with alternate turns round the leg to which the end is opposed. A further bandage of the same size covers the broomstick with a turn round the leg at each side. The appearance of the finished plaster is shown in Fig. 107

The plasters are dried as the child rests on mackintosh-protected pillows, but when completely dry, no special appliance or frame is necessary for nursing if regular toilet habits have been achieved. Until this time, pillows may have to be arranged to raise the buttocks off the bed so that a receiver may be placed suitably in the cot to prevent soiling of the upper part of the plaster. The child can sit and lie normally otherwise.

When the reduction is stable in a lesser degree of abduction and internal rotation, the legs may be brought down to the second position shown in Fig. 108. The plasters are applied in the same

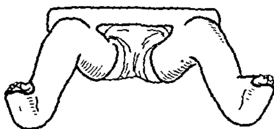


Fig. 108.—The Batchelor plaster in reduced internal rotation.

manner, but the broomstick is fixed in front just above the knee.

It must always be borne in mind that broomsticks and plaster struts used in any hip spica or leg plaster are applied to maintain abduction only. They are held by the minimum number of bandages to add as little weight as is possible, and are not strong enough to bear the strain of lifting.

Both plasters are renewed at intervals, when the degree of abduction and rotation is modified, depending on radiological and clinical stability of the joint, after examination out of plaster. Treatment on removal of the plasters consists of free movements in bed, after which gentle weight bearing is commenced with review in the out-patient department at regular periods of time.

CHAPTER X

PLASTERS FOR THE TRUNK AND NECK

THE PLASTER JACKET FOR SPINAL FRACTURES

FRACTURES of the bodies of the dorsal and lumbar vertebrae are treated in one of three ways:

1. Immediate immobilisation in a plaster jacket.
2. Bed rest with the spine hyperextended over pillows for a minimum period of eight weeks, followed by the application of a plaster jacket for a further period during which time the patient is ambulant.
3. Spinal fusion, with nursing carried out on a plaster bed.

If a fracture is reducible, the patient is usually treated without anaesthesia and plastered in a position which hyperextends the spine. Some surgeons have a preference for slings on which the patient is suspended and supported at the thighs, upper chest and forehead in the prone position. The most common method, however, is to use two parallel tables with the patient supported as shown in the diagram, Fig. 109. An injection of morphine or some similar sedative is given to take effect during the ten minutes required for the application of the plaster. The patient is transferred directly from the bed to the tables, and all preparation must be made before moving. A stockinette lining from a piece eight to twelve inches in width is rolled over the trunk and must be long enough to fit comfortably and without pulling when stitched at the shoulders and between the legs. The upper border is cut about eight inches down either side. The extra inches allow free movement of the arms when the front and back edges are brought together to be stitched over the shoulders (Fig. 110). The patient is rolled into the prone position on the bed and then carefully lifted to rest between the two tables. He supports himself at the thighs and upper chest, both of which are protected by a flat pillow. The arms are outstretched in front, and if the table is not too wide, he can grasp the edge by the hands and feel more secure.

The plasters are dried as the child rests on mackintosh-protected pillows, but when completely dry, no special appliance or frame is necessary for nursing if regular toilet habits have been achieved. Until this time, pillows may have to be arranged to raise the buttocks off the bed so that a receiver may be placed suitably in the cot to prevent soiling of the upper part of the plaster. The child can sit and lie normally otherwise.

When the reduction is stable in a lesser degree of abduction and internal rotation, the legs may be brought down to the second position shown in Fig. 108. The plasters are applied in the same

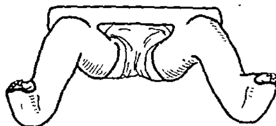


FIG 108.—The Batchelor plaster in reduced internal rotation

manner, but the broomstick is fixed in front just above the knee.

It must always be borne in mind that broomsticks and plaster struts used in any hip spica or leg plaster are applied to maintain abduction only They are held by the minimum number of bandages to add as little weight as is possible, and are not strong enough to bear the strain of lifting.

Both plasters are renewed at intervals, when the degree of abduction and rotation is modified, depending on radiological and clinical stability of the joint, after examination out of plaster. Treatment on removal of the plasters consists of free movements in bed, after which gentle weight bearing is commenced with review in the out-patient department at regular periods of time.

2. From the lower ribs, round the loins and buttocks.
3. A slab, eight inches by twenty-four inches, across the upper chest and moulded as shown in Fig. 111.
4. A slab, eight inches by twenty-four inches, above the symphysis pubis at the front.
5. One bandage from the sterno-clavicular joints to the symphysis pubis.
6. A slab, six inches by twelve inches, from under one arm to the iliac crest (Fig. 112).
7. A slab, six inches by twelve inches, to the opposite side.
8. Finishing bandage round the upper chest.
9. Finishing bandage *round the loins.*
10. Finishing bandage round the buttocks.



Fig 111 —Careful moulding in the clavicular region (Hamilton Bailey· *Surgery of Modern Warfare*)

Ten minutes is the maximum time required for completion, and with an efficient team the operation can be finished in less time. The patient often becomes restless under the strain, and speed in application is most important. He is returned to bed on his back and rolled on to a firm pillow with a mackintosh protecting cover, which fits under the lumbar spine.



Fig 112 —Lateral strip being applied (Hamilton Bailey *Surgery of Modern Warfare*)

Trimming is done with the patient recumbent. The top edge of the plaster should reach the level of the sterno-clavicular joint, and sufficient plaster should be cut away under each arm to allow full movement. At the lower border, the plaster reaches the symphysis pubis and is cut away at the groins until free flexion of both thighs to a right angle is possible. The outer lower

This position puts a great strain on the patient and is most uncomfortable and exhausting. The plastering must therefore be done with high speed by at least four persons. One assistant supervises the maintenance of correct hyperextension throughout the operation. A second prepares slabs and provides a steady supply of wet bandages from the bowls. The others quickly apply the circular bandages until the necessary thickness is obtained. Newspapers spread out on the floor between the tables catch



FIG 109.—Spinal jacket Position for application. (Hamilton Bailey *Surgery of Modern Warfare*)

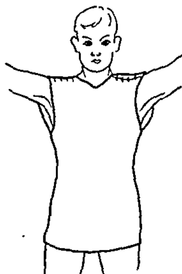


FIG 110.—The stockinette lining for the plaster jacket cut and stitched over the shoulders

the splashes of plaster cream which cannot be avoided. They are destroyed after use, and the theatre floor is clean in readiness for the next case. After positioning, the procedure is as follows

Prepared felt strips, two inches by twelve to eighteen inches, are placed on either side of the spine to protect the spinous processes, and two of two inches by nine inches are laid obliquely above the iliac crests to prevent pressure and rubbing Plaster wool is then rolled evenly from axillary level to the trochanters of the femur to make a double thickness including overlap.

Ten bandages, six inches by six yards, are used for a cast a quarter of an inch in thickness. The order of application is as follows:

1. Round the chest from the sterno-clavicular joints to the lower ribs.

2. From the lower ribs, round the loins and buttocks.
3. A slab, eight inches by twenty-four inches, across the upper chest and moulded as shown in Fig. 111.
4. A slab, eight inches by twenty-four inches, above the symphysis pubis at the front.
5. One bandage from the sterno-clavicular joints to the symphysis pubis.
6. A slab, six inches by twelve inches, from under one arm to the iliac crest (Fig. 112).
7. A slab, six inches by twelve inches, to the opposite side.
8. Finishing bandage round the upper chest.
9. Finishing bandage round the loins.
10. Finishing bandage round the buttocks.



Fig. 111 —Careful moulding in the clavicular region (Hamilton Bailey *Surgery of Modern Warfare.*)

Ten minutes is the maximum time required for completion, and with an efficient team the operation can be finished in less time. The patient often becomes restless under the strain, and speed in application is most important. He is returned to bed on his back and rolled on to a firm pillow with a mackintosh protecting cover, which fits under the lumbar spine.



Fig. 112 —Lateral strip being applied. (Hamilton Bailey *Surgery of Modern Warfare.*)

Trimming is done with the patient recumbent. The top edge of the plaster should reach the level of the sterno-clavicular joint, and sufficient plaster should be cut away under each arm to allow full movement. At the lower border, the plaster reaches the symphysis pubis and is cut away at the groins until free flexion of both thighs to a right angle is possible. The outer lower

border is trimmed at the level of the greater trochanter on each side. The plaster is bound with a three-inch plaster bandage applied loosely over the trimmed stockinette and well rubbed in. The back of the plaster is trimmed a few hours later when the patient is settled in bed and turning may be safely performed. The upper border is cut to the mid-dorsal spine and the lower

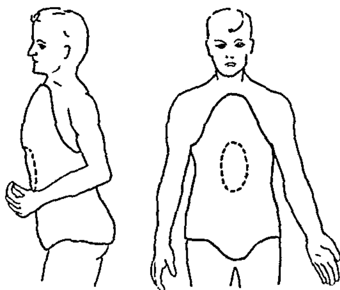


FIG 113 —The spinal plaster jacket (with area mapped out for window if necessary).

border trimmed over the sacrum to make sitting easy and comfortable. The cast is dry within forty-eight hours, and ambulation may then commence. It is retained for about three months.

Observation windows are cut over the fracture site and the epigastrium if necessary, in the former case if there is a wound or severe bruising, and in the latter if there is digestive disturbance and difficulty in breathing. A plaster without windows is a stronger cast (Fig. 113).

This type of plaster jacket may also be applied for scoliosis, but in this case head suspension apparatus is used to extend the spine, as described in Chapter I (The Plaster Theatre), and the cast covers the dorsal region and joins over each shoulder.

PLASTER COLLARS

There are two types of collar in common use, and both give support to the head and neck.

The simple collar (as used for neck strain) extends from the occiput to the mid-dorsal region at the back, and is continued to the angle of the jaw in front leaving the lower jaw free for speaking and chewing, and down over the shoulders and upper chest. This plaster restricts flexion, extension and rotation of the head, and limits the movements of the cervical spine.

It is applied with the patient seated. A length of stockinette, eight inches in width, is rolled over the head and neck and stretched over the shoulders and upper arms. The top edge is gathered on the crown of the head and fastened with a small piece of bandage. A portion is cut out to free the eyes, nose and mouth, and one layer of plaster wool is then rolled evenly over the area to be covered with plaster with an anchoring turn over the head and under each axilla. Plaster bandages needed are twelve of four inches by four yards. The basis of the plaster is a framework of four slabs applied as shown in Fig. 114. Each is made from two bandages, and the average measurements are as follows:

1. A front slab, nine inches long, four inches wide at one end and six inches wide at the other.
2. A back slab, twelve inches long, four inches wide at one end and eight inches wide at the other.
3. }
4. } Two of four inches by eighteen inches to cross from the occiput under the ear and then diagonally across the neck and chest to the opposite pectoral region

The remaining four bandages fix the slabs in position, and as the contours of the head, neck and shoulders vary considerably, each circular turn is pleated on its slack edge at three-inch intervals so that the bandage can be rubbed smoothly into the preceding turns and form a thin but solid mass. Setting time is about five minutes, and during this period it is essential that the patient does not move. The head is supported by an assistant throughout the operation, and two persons should apply the plaster. Each prepares two of the four initial slabs at the same time, and applies them in the order given

Trimming at the upper border should be sufficient to free the

ears and lower jaw, but should not permit lateral movement. The lower border is trimmed to a round, smooth edge over the body of the sternum and pectoral regions, upwards over the shoulders to allow free movement of the arms, and downwards in a smooth curve to the mid-dorsal region. The stockinette is

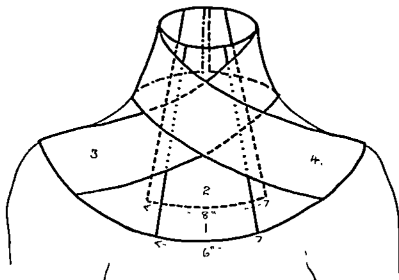


FIG 114—The simple plaster collar The four slabs form an adequate frame on which to finish the collar.

cut to turn back one inch, the excess plaster wool removed, and both borders are then bound with a two-inch plaster bandage. The collar is worn for four to six weeks according to the relief of symptoms.

THE MINERVA COLLAR OR JACKET

This plaster is applied for fracture, or fracture-dislocation of the cervical spine, and for severe cervical disc lesions. It fits the head like a Balaclava helmet, *reaches the level of the eyebrows*, leaves the ears free but covers the angle of the jaw, and is trimmed to leave the arms free and to fit well down to the iliac crest on either side.

The method of application is as follows:

1. Without Head Suspension

The patient is seated with the back straight, the shoulders square, the neck extended, and the head placed to permit clear

vision of the ground in front of [illegible]
[illegible]

2. With Head Suspension

The patient stands upright and keeps the arms away from the body by holding the apparatus at each side above the head. The suspension apparatus may be a simple calico bandage sling which holds the head firmly at the forehead, lower jaw and occiput, and is attached by its free ends to an adjustable appliance suspended from the ceiling, or a frame specially designed for this purpose.

3. If Skull Calipers have been used

The patient is transferred to a table and the plaster is applied in dorsal recumbency with the shoulders off the table. *The extension cord with the weights attached should always remain in a line corresponding with the traction over the bed pulley. The weights are not removed until the head and neck are encased in plaster.* The trunk portion of the plaster is then completed with the patient in a sitting position In this case the routine method of application cannot be followed. Reduction of a fracture is sometimes attempted in the first instance by manipulation and immediately followed by application of the plaster. This is usually done as the patient lies flat on his back supported between the shoulders by a thin wooden rest extending from the end of the table (Fig. 115). The trunk portion is finished when the head, neck and shoulders are held effectively.

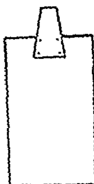


FIG. 115.—The narrow shoulder rest which can be made by the carpenter to fit firmly on the table as required

The hair of all patients should be as short as possible, otherwise general discomfort will be experienced due to the difficulty in closely moulding the cast over a large amount of hair, the warmth which the bulk retains, and the itching as a result. Explanation of these complications will often result in permission from the patient to cut the hair to a reasonable length. *This should never be done without permission.*

A lining is made from two pieces of stockinette, one to cover the head and neck, and the other to cover the trunk. The chest

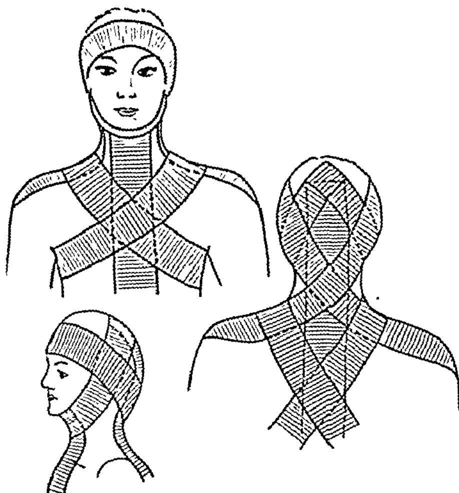
piece is cut eight inches down either side of the upper border and one inch down the middle back and front. The opposing edges are brought together and stitched flat over the shoulders. Excess round the neck is cut away. The lower edge of the head piece is stretched to fit neatly on the other at the neck and stitched flat. The edge may curl at certain points, and trimming close to the stitching is necessary. A small hole is cut over the face to allow free breathing and to enable the patient to see, but there must be sufficient left to form a neatly trimmed edge when the stockinette is turned back away from the face and ears. The upper end of the head portion is gathered together by a strip of bandage tied over the crown. Felt strips are placed above the iliac crests and down either side of the dorsal and lumbar spine. Plaster wool rolls are then applied over the whole lining, ensuring an adequate padding round the chest where it is needed most, but providing a minimum around the head and neck.

The cast is made from a basis of six slabs, four applied at the start and two shoulder slabs fixed after these have been secured by circular bandages. The necessary plaster bandages for an adult are seventeen of four inches by four yards and three of six inches by six yards. The three diagrams (Figs. 116, 117 and 118) clearly show the extent and order of application:

1. A slab made from one four-inch bandage is applied from the chin over the front of the chest to the waist. It measures four inches by eighteen inches.
2. A slab, four inches by twenty-four inches, made from two four-inch bandages, extends from the crown of the head, fits close to the neck and reaches to the lumbar region.
3. A slab, four inches by twenty-four inches, made from two four-inch bandages, overlaps the top edge of the first slab under the chin, is pulled firmly behind the ears and anchors the second slab at the top by an overlapping cross-turn of the ends.
4. A slab, four inches by thirty-six inches, made from two four-inch bandages, the middle of which is applied over the forehead above the eyebrows and overlaps the third slab behind the ears and the second slab at the back of the neck, where the ends cross to lie over each shoulder.

The slabs are prepared quickly by an assistant and applied and

moulded to the respective parts by the operator and one other assistant who immediately fix them in position by circular turns of plaster bandage, four inches by four yards. The first bandage



FIGS 116, 117, 118 —Slabs for the Minerva collar (*Top left*, Front view *Bottom left*, Side view. *Right*, Back view.)

is commenced under the chin, taken round the back of the neck, forward under the chin, then upward over the back of the head and round the forehead. Turns are repeated downward from the forehead to the occiput The second bandage starts under the chin, a few turns are made round the ears to reinforce the third slab and the remainder is continued in downward turns toward the neck. The third bandage starts round the neck and is brought

as low over the shoulders as is possible. Tucks are necessary at four-inch intervals to fit the contours of the neck and shoulders. At this point two shoulder slabs, four inches by thirty-six inches, are quickly prepared, each from two four-inch bandages, and fixed as shown in the diagrams. The last three four-inch bandages are applied round the neck and over these slabs, and are directed downward with succeeding turns to cover the shoulders, upper dorsal region and chest. The operator then finishes the trunk portion.

One bandage, six inches by six yards, is commenced obliquely at the shoulder in front, turned back neatly over the manubrium sterni and continued over the opposite shoulder to the upper dorsal region, where it is reversed and again brought to the front. These reverse turns are repeated, each one directed an inch lower than the preceding turn. The two further bandages of six inches by six yards are rolled firmly and evenly from the axillae to the iliac crests.

Trimming

A skilful hand is essential for cutting away excess plaster. The top of the head is exposed for ventilation, the ears are freed, and sufficient plaster is removed from under the chin for easy chewing and speaking. The stockinette is turned back round the trimmed edges and bound by two-inch plaster bandages The arms and lower border are trimmed and bound likewise, and the finished cast should be comfortable and reasonably light in weight when dry. Figs 119, 120 and 121 show the front, side and back views of a Minerva jacket.

PLASTER BEDS

Certain spinal injuries and diseases are treated by nursing on a plaster bed. The type of bed used depends on the site to be treated

1. Cervical and Upper Dorsal Spine

A head extension to the plaster is essential. A band of webbing or extension tape, one and a half inches wide, is incorporated in the plaster at one side, brought over the forehead and fastened to a buckle which is attached to a short piece of webbing fixed in the



FIG. 119



FIG. 120

FIG 119 —Front view of the finished Minerva collar. Note how the lower jaw is free for chewing and speaking.
FIG 120 —Side view of the finished Minerva collar, showing how plaster is cut to allow full circumduction of the arm, and the trimming round the ear which prevents lateral movement of the head



FIG 121 —Back view of the finished Minerva collar.

as low over the shoulders as is possible. Tucks are necessary at four-inch intervals to fit the contours of the neck and shoulders. At this point two shoulder slabs, four inches by thirty-six inches, are quickly prepared, each from two four-inch bandages, and fixed as shown in the diagrams The last three four-inch bandages are applied round the neck and over these slabs, and are directed downward with succeeding turns to cover the shoulders, upper dorsal region and chest. The operator then finishes the trunk portion.

One bandage, six inches by six yards, is commenced obliquely at the shoulder in front, turned back neatly over the manubrium sterni and continued over the opposite shoulder to the upper dorsal region, where it is reversed and again brought to the front. These reverse turns are repeated, each one directed an inch lower than the preceding turn The two further bandages of six inches by six yards are rolled firmly and evenly from the axillae to the iliac crests.

Trimming

A skilful hand is essential for cutting away excess plaster. The top of the head is exposed for ventilation, the ears are freed, and sufficient plaster is removed from under the chin for easy chewing and speaking. The stockinette is turned back round the trimmed edges and bound by two-inch plaster bandages. The arms and lower border are trimmed and bound likewise, and the finished cast should be comfortable and reasonably light in weight when dry. Figs 119, 120 and 121 show the front, side and back views of a Minerva jacket.

PLASTER BEDS

Certain spinal injuries and diseases are treated by nursing on a plaster bed. The type of bed used depends on the site to be treated.

1. Cervical and Upper Dorsal Spine

A head extension to the plaster is essential. A band of webbing or extension tape, one and a half inches wide, is incorporated in the plaster at one side, brought over the forehead and fastened to a buckle which is attached to a short piece of webbing fixed in the

under the lower legs above the ankles to provide slight knee flexion. The feet are left free of the end of the table. If the bed is required for post-operative nursing after bone grafts, it is made several days before, when the spine is manipulated to the best position possible and held in position by two responsible assistants until the plaster has been applied and is firm (Figs. 122 and 123).



FIG. 123.—Position of patient for spinal plaster bed. (Hamilton Bailey: *Surgery of Modern Warfare.*)

Preparation of the Skin

If wet plaster is in direct contact with an untreated skin, it is difficult to remove when set, causes pain to the patient due to tiny hairs being incorporated, and can produce a severe skin irritation in sensitive people. As plaster beds are not often padded before application, the skin is rubbed with olive oil or vaseline over the area to be covered. The hair is protected by a rubber cap, which is removed and washed afterwards. The finished shell leaves the skin quite easily when set, and marks from plaster cream on the body wash off without effort.

Methods of applying a Posterior Shell

1 From a body slab cut to shape at the neck, shoulders and arms before application and extending over the thighs, with the leg extensions made from bandages prepared as a slab and the whole reinforced by bandages applied in reverse turns up and down the whole by two persons.
2 From bandages only with reinforcing slabs prepared in the usual way, and finished with further bandages applied in reverse turns from side to side and up and down until a quarter of an inch thickness is obtained. *The bed is never made more than a quarter of an inch in thickness as it lies on the patient. Extra thickness is given after removal.*

FIRST METHOD. Three persons are needed, two to mould the slabs and one to maintain the supply of bandages. The main

plaster on the opposite side. A strip of adhesive felt makes suitable padding for the part of the band which lies on the forehead.

2. Lower Dorsal and Lumbar Spine

For lesions affecting these regions, the usual plaster bed extends from the shoulders to about two inches above the malleoli on each leg, but in some cases in which active foot movements are impossible due to spinal cord lesions or unconsciousness, foot extensions are necessary to prevent drop foot deformity. These are most effective when made as separate below-knee shells which fit over the lower leg portions of the bed and are bandaged into position.

Anterior Turning Cases

Patients immobilised in a posterior plaster bed cannot lie undisturbed in the bed for the whole period of fixation. Extra care to the skin and pressure areas must be given, and a turning case is necessary for adequate nursing which will not interfere with the position of the spine Cervical and upper dorsal spine lesions require an anterior head extension to the normal anterior shell which extends from the shoulder level to above the ankles.

Preparation of the Patient

The patient lies face downwards on a table about three feet in height, which is first covered by a narrow orthopaedic blanket. Mackintosh protective covers are suitably placed round the patient. A small pillow supports the head and neck and keeps the chin off the table. The head should be straight, in line with the spine The arms are extended comfortably to rest by the side of the body. The legs are abducted sufficiently for toilet procedures without the risk of soiling the cast, the knees rest on the table, but a flat pillow is put



FIG 122.—Preparation of table for plaster bed. (Hamilton Bailey *Surgery of Modern Warfare*)

slab moulded well over this and continued over the buttocks and thighs (Figs. 125, 126 and 127). The leg slabs overlap the body slab from the buttocks providing additional strength. The layers of the body slab should be graduated in length at the leg to avoid a ridge of plaster where the leg slabs overlap. A 'strut' is made from a six-inch bandage to the required length and fixed on by reverse turns of bandage to secure each end, with circular turns over the 'rope' to strengthen it. These turns should be well rubbed in. The marks for trimming round the sacrum and at the sides are then made. The shell becomes firm within ten minutes and is carefully removed by three people, one holding at the shoulders, one at the buttocks and the third at the ankles (Fig. 128). After its removal, the patient is washed and dried, given warm clothing and returned to a warm bed. The cast is trimmed, reinforced to a half-inch thickness and then left to dry in a warm room.



Fig. 127.—Lateral strips being applied. (Hamilton Bailey: *Surgery of Modern Warfare*.)



Fig. 128.—Plaster being lifted off carefully. (Hamilton Bailey: *Surgery of Modern Warfare*.)

Second Method. Two persons can apply a posterior shell using bandages only. It is customary to make a straight slab twelve to sixteen inches wide from three bandages of six inches by six yards to cover the spine from the neck to the coccyx, and cut for moulding round the arms. This is to ensure a smooth surface on an unlined cast. Felt is applied as before, the slab fixed and further bandages rolled to and fro over the back and sides, ensuring an even thickness at all parts. Leg slabs are made to extend from the buttocks to the ankles, and these are reinforced

slab may be a proprietary one of 'Gypsona', which is 'fed' through warm water, excess moisture allowed to drip from it, and then applied directly to the back; or it may be made from four layers of plain plaster muslin, each of at least six thicknesses, soaked in plaster cream, excess moisture allowed to drip, and applied as before. Home-made slabs and bandages are the more durable, but take longer to set. The plaster cream is not made until the muslin is ready for immersion. It is prepared in an enamel pail or a large flat tray, and must be used quickly because of its short setting time (Fig. 124).



FIG 124.—Mixing the plaster paste. (Hamilton Bailey *Surgery of Modern Warfare*)

The leg extension slabs are shaped as they are rolled out, one end made to the width of the buttock and the other not more than eight inches wide. Each is prepared from three bandages, six inches by six yards. The total number of bandages needed varies in relationship to the size of the patient and the extent of the bed Bony prominences should always be protected by sheet felt cut to size to cover the iliac crests, spinous processes and scapulae These are placed in position by the third person as the main slab is fixed from above to below by the two persons moulding the cast: for example, scapulae and spine felt positioned, upper part of slab moulded to the shoulders and back, iliac crest felt positioned, and the



FIG 125—Wet sheet being laid on the patient (Hamilton Bailey *Surgery of Modern Warfare.*)



FIG. 126—Careful moulding over crests of ilium and loins (Hamilton Bailey. *Surgery of Modern Warfare.*)

layer by well rubbing in and binding with bandage rolled between the ridges and continued beyond the edges to adhere to the original cast (Fig. 131).

Trimming

A cobbler's knife is used for this purpose, or a scalpel, whichever is more convenient. The neckline, shoulders and arm edges are smoothed, and the sides levelled. An area is cut away for toilet purposes, but must not be so large as to allow the buttocks to protrude, or extreme discomfort and pressure sores will result.

Lining and Padding

A well-made shell should not require padding other than the felt which is incorporated in the plaster, but when the bed is in use for several months a lining is desirable. Some patients sweat freely, and a lining prevents the cast from becoming damp and uncomfortable. It may be made from lint fixed in position by adhesive tape on the outer side of the bed, or a separate removable gamgee shape may be cut and bound by ribbon gauze. It is necessary to change the lining frequently when the patient is turned, as the material holds an unpleasant odour from sweat and also becomes rough on the surface if left too long. An alternative method which is sometimes employed is to cover the cast with a sheet of plaster wool over which stockinette is stretched to shape and cut to turn back at the edges. This is bound as before with adhesive tape (Fig. 132).

The Anterior Shell

This is applied as the patient lies in the posterior half to ensure correct positioning. It is applied from the shoulders to above the ankles, and mackintosh covers are arranged round the table and tucked in over the sides of the posterior bed to prevent plaster cream running down inside and soiling the posterior shell. This shell is 'ridged', trimmed to fit the edges of the posterior half and dried in the same manner.

Head Extensions

The anterior extension consists of a slab across the forehead fixed on each side by a stout strut, the ends of which are firmly

by further bandages. The cast is removed after the strut has been fixed, and for this purpose the help of a third person should be obtained. It is reinforced to a half-inch thickness and then dried in the usual manner.

Reinforcing the Shell

A complete shell of a half-inch thickness makes a very heavy



FIG 129 —'Ridging' a straight slab by making tucks

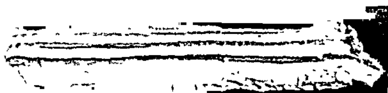


FIG 130 —The appearance of a 'ridged' slab.

cast difficult for nurses to handle This problem is overcome by a method of reinforcement known as 'ridging'. Extra slabs are prepared double the required width of the part to be covered. These are then taken up at regular intervals, holding about two inches between the thumb and forefinger, squeezing together along the whole length (Fig. 129) and producing a strong slab as shown in Fig. 130. These ridged slabs need no further reinforcement, but must be securely fixed into the underlying

layer by well rubbing in and binding with bandage rolled between the ridges and continued beyond the edges to adhere to the original cast (Fig. 131).

Trimming

A cobbler's knife is used for this purpose, or a scalpel, whichever is more convenient. The neckline, shoulders and arm edges are smoothed, and the sides levelled. An area is cut away for toilet purposes, but must not be so large as to allow the buttocks to protrude, or extreme discomfort and pressure sores will result.

Lining and Padding

A well-made shell should not require padding other than the felt which is incorporated in the plaster, but when the bed is in use for several months a lining is desirable. Some patients sweat freely, and a lining prevents the cast from becoming damp and uncomfortable. It may be made from lint fixed in position by adhesive tape on the outer side of the bed, or a separate removable gamgee shape may be cut and bound by ribbon gauze. It is necessary to change the lining frequently when the patient is turned, as the material holds an unpleasant odour from sweat and also becomes rough on the surface if left too long. An alternative method which is sometimes employed is to cover the cast with a sheet of plaster wool over which stockinette is stretched to shape and cut to turn back at the edges. This is bound as before with adhesive tape (Fig. 132).

The Anterior Shell

This is applied as the patient lies in the posterior half to ensure correct positioning. It is applied from the shoulders to above the ankles, and mackintosh covers are arranged round the table and tucked in over the sides of the posterior bed to prevent plaster cream running down inside and soiling the posterior shell. This shell is 'ridged', trimmed to fit the edges of the posterior half and dried in the same manner.

Head Extensions

The anterior extension consists of a slab across the forehead fixed on each side by a stout strut, the ends of which are firmly

bound by reverse turns of bandage. It is important that this portion of the cast is made with the rest, otherwise the strut and bandages will not unite firmly with the underlying layers. Wet plaster sticks to wet plaster and produces a whole mass. Wet plaster applied to partially dry plaster requires much rubbing in to obtain good results.

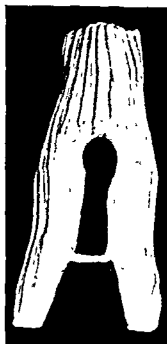


FIG 131

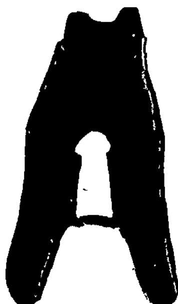


FIG. 132

FIG 131 —The ridged slabs well rubbed in to the underlying layers.

FIG 132 —A finished plaster bed which has been lined with stockinette over one layer of plaster wool and bound by two-inch plaster bandage.

The posterior head extension may be prepared as part of the initial slab or be made from repeated reverse turns of bandage. The webbing is incorporated between the layers and is stronger, and easier to fix, if both ends are from one piece fixed across the plaster. The trimming should allow the ears to be free, but should permit the fixation of the back of the head as far as the vertex. The buckle is stitched firmly to the short end when dry and the protective felt stuck on the opposite end at the same time.

Foot extensions are required in comparatively few cases. They are made as padded below-knee plasters, taken round the leg portions of the bed, and when set the front portion is removed leaving a posterior half to fit over the bed and applied as necessary. The stockinette is turned back one inch over the edge and bound by two-inch plaster bandages. Domette bandages hold the splints in position satisfactorily, but several turns of bandage are needed at the top of the splint.

Turning

This should be carried out by at least four persons. The two shells are held together by belts of wide webbing with large

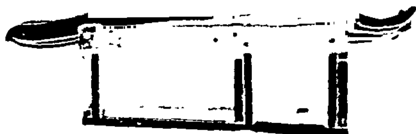


FIG. 133.—A wooden support on which a plaster bed rests. These supports are inexpensive because they can be modified to be used again

buckles attached. There should be one over the chest, one round the loins, a third over the groins and a smaller one round each leg. Two nurses stand on each side and firmly grasp the cast at the sides over the lower chest and upper thighs The left arm controls the speed of turning, whilst the right arm in each case supports the patient during turning. The patient is lifted, one nurse issues instructions, and turning in the air is done smoothly and rhythmically and the patient gently lowered to his new position. The upper shell is then removed, bandages applied to hold the patient in the other, and nursing is continued without disturbance to the lesion.

A wooden support made by the hospital carpenter is the best method of supporting the bed. It rests on a covered fracture

board, and is raised about nine inches to allow usage of a urinal and bedpan. The upright rests are positioned under the shoulders, lower lumbar region and knees, and under the lower legs if necessary (Fig. 133). Pillows are arranged at the head and feet if support is needed.

INDEX

Printed in Great Britain
at Hopetoun Street, Edinburgh,
by T. and A. Constable Ltd
Printers to the University of Edinburgh